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PHYSICS ABSTRACTS

PTEMBER 1958

Published by The Institution of Electrical Engineers

SECTION A OF SCIENCE ABSTRACTS

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Electronic relays and counters	Transistors	Amplifiers
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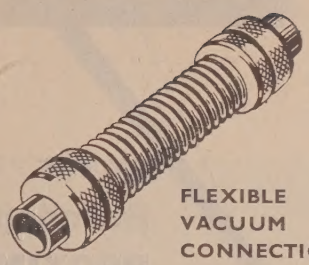

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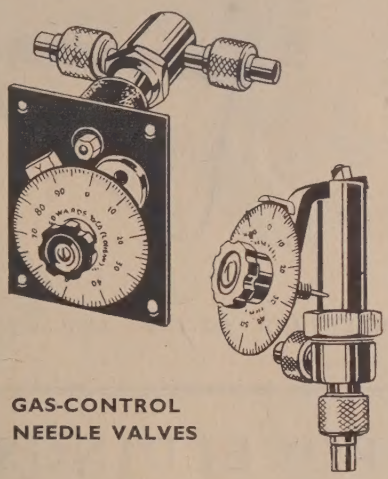

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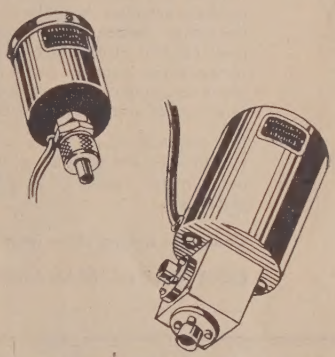

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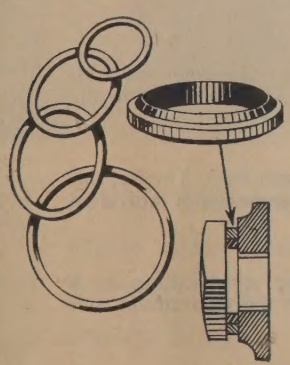

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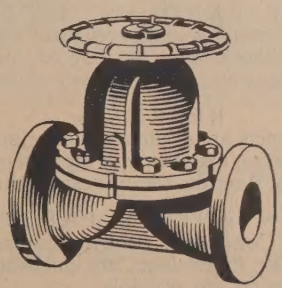

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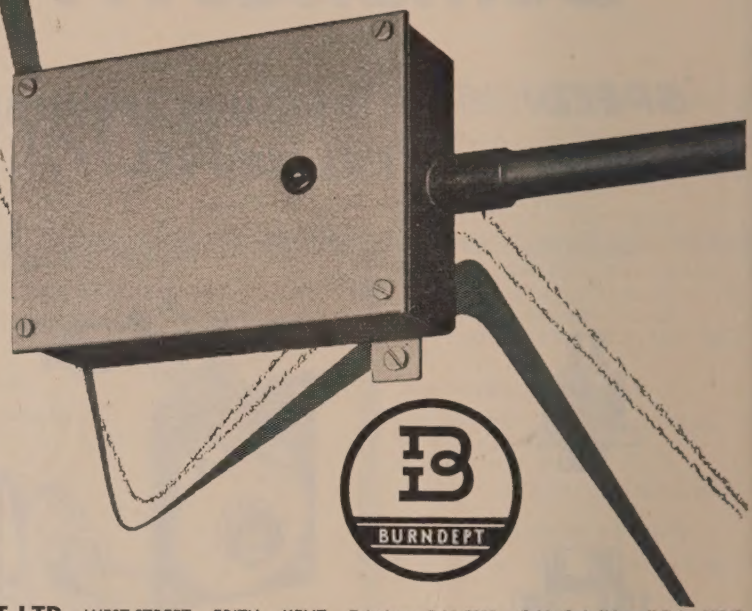

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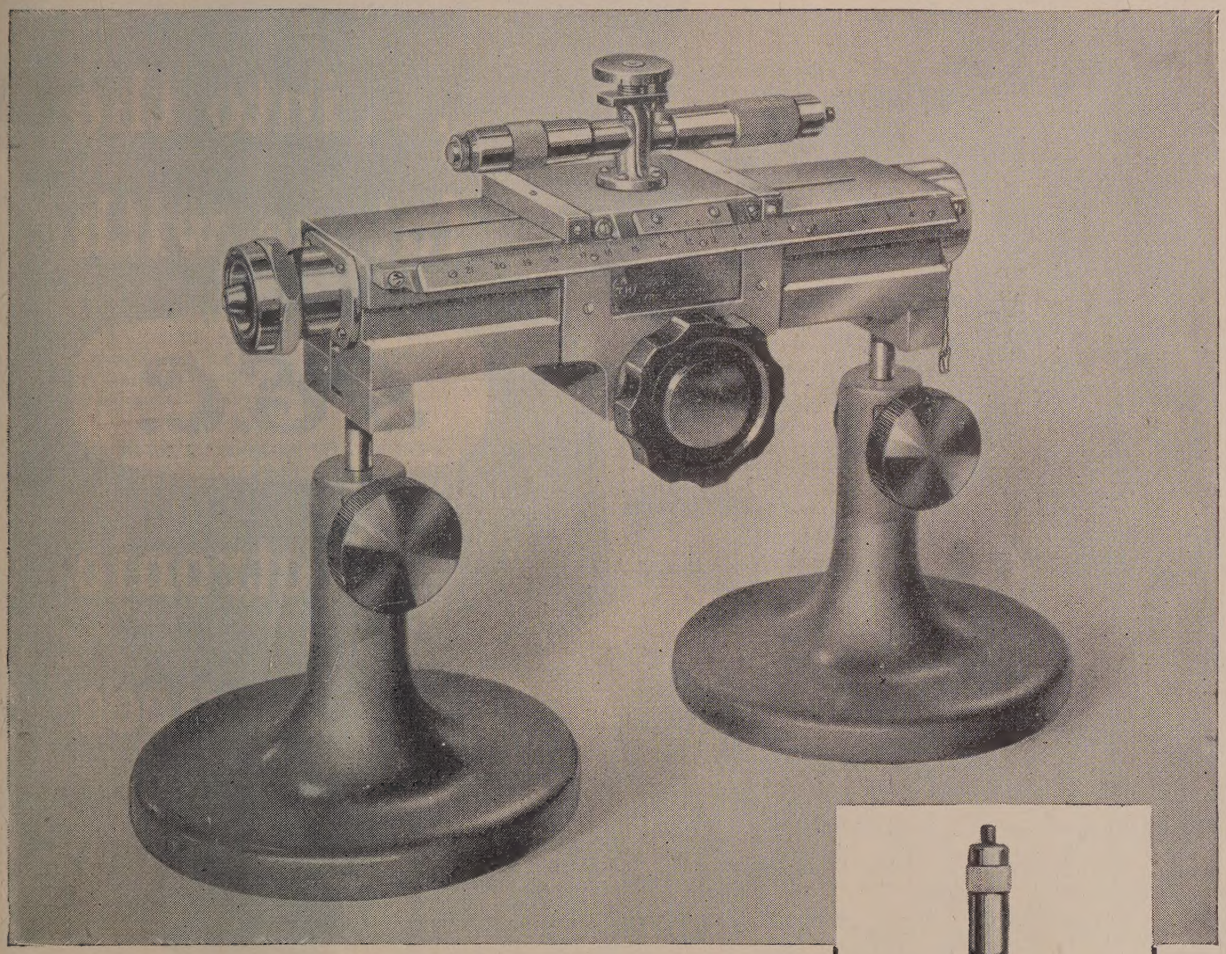

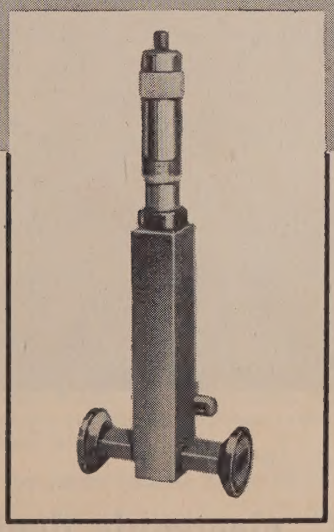

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PHYSICS ABSTRACTS

Volume 61 SEPTEMBER 1958 Number 729

MATHEMATICS

517.3

5574. TABLES OF TRANSPORT INTEGRALS

$$J_n(x) \equiv \int_0^x \frac{e^z z^n dz}{(e^z - 1)^2}$$

W.M.Rogers and R.L.Powell.
Circ. Nat. Bur. Stand., No. 595, 46 pp. (1958).

The tables include values to six significant figures of the integral for the index integer (n) ranging from 2 to 17, and for the limit of integration (x) ranging from 0.1, by 0.1 intervals, to the limiting upper value, that ranges from 25 for n = 2 to 40 for n = 7. The three series utilized to represent the integral in different ranges are derived. The limiting values in the upper range and the asymptotic series expansions in the lower range are also given. Auxiliary tables include the values of the Riemann Zeta numbers and Bernoulli numbers utilized in the calculations. A.

517.512.2

5575. ON NUMERICAL FOURIER TRANSFORMATION, WITH SPECIAL REFERENCE TO LIPSON–BEEVERS STRIPS. P.Fellgett.
J. sci. Instrum., Vol. 35, No. 7, 257-8 (July, 1958).

Lipson–Beevers strips were used in trials for illustrating, in two special cases, the effect of rounding-off errors in numerical Fourier transformation. No evidence was found to support the suggestion, sometimes put forward by false analogy with the Gibbs phenomenon, that such errors lead to systematically oscillatory residuals in the calculated ordinates. A.

517.9

5576. DISTURBANCE OF A MANY-DIMENSIONAL FIELD SATISFYING THE HELMHOLTZ EQUATION DUE TO THE PRESENCE OF A HYPERPLANE BOUNDARY.
G.C.K.Yeh and J.Martinek.
Proc. Roy. Soc. A, Vol. 246, No. 1246, 423-8 (1958).

The disturbance function of an n-dimensional field satisfying the Helmholtz equation due to the presence of a hyperplane boundary is expressed in terms of the undisturbed function. The field may contain singularities on both sides of the boundary. In the special case of a field satisfying the Laplace equation in three dimensions the boundary conditions include those in hydrodynamics, heat, magnetism, and electrostatics. A.

ASTRONOMY . ASTROPHYSICS

522.6 : 535.33.07

5577. THE OPTICAL DESIGN OF A SOLAR SPECTROGRAPH.
C.Morais.
Atti Fond. Ronchi, Vol. 12, No. 2, 133-50 (March-April, 1957).
In Italian.

The results are given of the computation of an objective formed by two spherical reflecting surfaces. Because of the small aperture, a purely analytic method of design was possible. The wave aberration and spherical aberration are shown to be about one fifteenth of the optical tolerance. The light distribution in the focal plane is also calculated. R.W.Fish

522.615

5578. CURRENT INTEGRATOR FOR ASTRONOMICAL PHOTOELECTRIC PHOTOMETRY. R.H.Weitbrecht.
Rev. sci. Instrum., Vol. 28, No. 11, 883-8 (Nov., 1957).

An integrator circuit is described, together with programmer and timer, which was constructed for measuring signal-current from a photomultiplier tube as used in astronomical photometry. At the end of a timed run, the voltage data are impressed upon a strip-chart pen recorder. The current-range of such an instrument encompasses a span from 10^{-6} to 10^{-11} ampere, full scale, with stability and linearity. Furthermore, the design is such that, using a suitable programming circuit, any number of identical integrator units can be employed to measure a like number of separate phototube currents simultaneously over a given timed run; and afterwards the separate voltages are recorded in sequence upon the one recorder. This feature makes the described system very useful for simultaneous multicolour photoelectric photometry. A.

523.03 : 530.19

MILNE'S PROBLEM WITH AN ARBITRARY INDICATRIX. See Abstr. 4772

523.03 : 532.5 : 538.3

SWEET'S MECHANISM FOR MERGING MAGNETIC FIELDS IN CONDUCTING FLUIDS. See Abstr. 5130

523.03 : 532.5 : 538.3

MAGNETIC FIELDS IN A CONDUCTING FLUID SPHERE WITH VOLUME CURRENTS. See Abstr. 5131

523.03 : 539.17

NUCLEAR FUSION AND SIZE OF CELESTIAL BODIES. See Abstr. 5400

523.16

5579. A GALACTIC MODEL FOR PRODUCTION OF COSMIC RAYS AND RADIO NOISE. L.Marshall.
Proc. Inst. Radio Engrs., Vol. 46, No. 1, 215-20 (Jan., 1958).

A model for a galaxy with observable spiral arms is proposed. The magnetic field of the spiral arms, together with a magnetic halo which is a natural extension of the field of the arms, make the parts of a Fermi accelerator for charged particles. The particle energies are such that the high-energy tail approximates a cosmic-ray spectrum, while the lower-energy particles account for the radio radiation of the galaxy. The accelerating process depends upon fluctuations of magnetic lines of force due to disturbances in the halo. A semi-quantitative analysis of the theory is made, and results compared with radio observations of spirals and with observations of 21 cm radiation in the galaxy, especially wavelength shifts. M.W.Ovenden

523.161 : 534.222.2

5580. SHOCK WAVES IN INTERSTELLAR SPACE. III. GASO-MAGNETIC DISCONTINUITIES. S.A.Kaplan.
Astron. Zh., Vol. 34, No. 3, 321-27 (1957). In Russian.

Formation of magnetic-field discontinuities which are connected with shock waves is studied. It has been assumed up to now that when the gas passes over a magnetic discontinuity the full flow of energy is conserved (e.g. R.Lüst, Abstr. 5523/1955). In the present paper the case is considered where luminescence occurs and the above condition does not hold. S.Chomet

523.164.32 : 523.755

A MODEL OF THE INNER CORONA BASED ON RADIO DATA. See Abstr. 4662

523.164.85

5581. THE DISTRIBUTION OF METEOR RADIO ECHOES ACCORDING TO THEIR DURATION. E.I.Fialko.
Astron. Zh., Vol. 34, No. 2, 241-6 (1957). In Russian.

First order theoretical calculations and experimental results

show that the distribution of signals reflected from persistent meteor trails is given by (for $\lambda = 10$ m)

$$N = N_S \frac{T_{min}}{T},$$

where N is the number of meteors giving reflections of duration $T \geq T_{min}$, and N_S the total number of observed meteor echoes.

S.Chomet

523.164.85 : 523.5

THE INITIAL RADIUS OF METEORIC IONIZATION TRAILS. See Abstr. 4645

523.51

5582. COSMIC-RAY EVIDENCE ON THE ORIGIN OF METEORITES. S.F.Singer.
Nuovo Cimento, Vol. 8, No. 4, 539-48 (May 16, 1958).

The birth of a meteorite coincides with the break-up of its parent body and also with the beginning of the meteorite's exposure to cosmic rays. This continued exposure creates through nuclear evaporations definitely calculable amounts of He^3, about $\frac{1}{3}$ of it by way of tritium. Hence the date of break-up can be obtained from the He^3 content; or better still, from the He^3 and tritium content measured in the same sample. However, the latter method has only limited applicability. The two methods give good accord; of six meteorites dated, all are found to be about 300 million years old. This agreement establishes confidence in the calculations of the He^3 production rate and leads to some considerations concerning the process of nuclear excitation. The age is also in good accord with Öpik's calculation of the mean lifetime of meteorite-like bodies against capture by the inner planets. From this agreement conclusions can be drawn concerning the mechanism of meteorite creation and concerning the relative constancy of cosmic-ray intensity as far back as 300 million years. A.

523.531

5583. THE RANDOM OCCURRENCE OF METEORS IN THE UPPER ATMOSPHERE. T.J.Keary and H.J.Wirth.
J. geophys. Res., Vol. 63, No. 1, 67-75 (March, 1958).

An experimental study was made of the distribution of time intervals between bursts of 43.5 Mc/s signals received over a 690 km path from Stanford to San Diego, California, with the object of determining whether or not the bursts occurred completely at random. The distribution of time intervals observed is consistent with the distribution expected if the bursts are produced by scattered radiation from the ionized trails of meteors, which enter the upper atmosphere at random. The number of time intervals observed of less than one second is appreciably less than the number calculated. This would be the case if some bursts were not observed when the interval between bursts is comparable to the duration of the bursts. The difference between observed and calculated values for large intervals for which the actual number of observations is small is not statistically significant. The observed number of triplets of equally spaced bursts substantially agrees with the number expected if the burst occurred at random. The data used in this analysis were the intervals preceding 778 bursts observed during 0400-0600 hours on 3 August 1956, and those preceding 446 bursts observed during 0500-0700 hours on 6 November 1956. A.

523.531 : 551.578.13

RELATION BETWEEN METEOR SHOWERS AND THE RAINFALL OF AUGUST, SEPTEMBER AND OCTOBER. See Abstr. 5548

523.67 : 535.333

C_3 BAND EMISSION IN COMETARY SPECTRA. See Abstr. 4866

523.7

5584. CORONAL STREAMERS. E.Ya. Bugoslavskaya.
Astron. Zh., Vol. 34, No. 2, 233-6 (1957). In Russian.

The data on the directions of coronal streamers indicate the existence on the sun of a general magnetic field, as well as local fields. The intensity of the local fields depends on the phase of the solar activity. S.Chomet

523.72

5585. THE DESTRUCTIVE EFFECT OF SOLAR CORPUSCULAR RADIATION ON SMALL PARTICLES. J.A.Wood,Jr.
Astrophys. J., Vol. 127, No. 1, 241-2 (Jan., 1958).

Theoretical estimation of the sputtering efficiency of solar corpuscles on the zodiacal cloud, based on the theory of radiation damage due to Seitz (Abstr. 1893/1950) and experimental results on sputtering obtained by Keywell (Abstr. 4744/1955). J.Dutton

523.75

5586. THE DISTRIBUTION OF FLARE HEIGHTS AS DERIVED FROM LIMB FLARES. R.G.Giovanelli and M.K.McCabe.
Austral. J. Phys., Vol. 11, No. 1, 130-4 (March, 1958).

Analysis of 90 flares recorded photographically with the Sydney (N.S.W.) Lyot monochromator yields frequency distributions with a mean flare height of 7.3×10^3 km, and a mean flare area of 1.2×10^8 km^2. D.R.Barber

523.75

5587. OBSERVATION OF A NEW TYPE OF FLARE.
R.J.Bray, R.E.Loughhead, V.R.Burgess and M.K.McCabe.
Austral. J. Phys., Vol. 10, No. 2, 319-23 (June, 1957).

The Hα solar patrol at Sydney recorded a new type of solar outburst on November 12, 1956, which had all the properties of a small flare except that it was characterized by the ejection with high velocity of a mass of very bright material, some 28° from the solar limb, several minutes before flare maximum. As the material moved outwards it brightened appreciably, reaching maximum intensity in the corona some $3\frac{1}{2}$ min after expulsion. G.M.Brown

523.75

5588. SOLAR ERUPTION IN INTEGRATED LIGHT.
M.Waldmeier.
Naturwissenschaften, Vol. 45, No. 10, 236-7 (1958). In German.

The flare was observed visually at three stations in Switzerland simultaneously on 23 March 1958. Its long duration (09h 50m-10h 55m U.T.) enabled a photograph to be taken at Locarno. Pronounced terrestrial disturbances followed, including short-wave radio fade-out, enhanced atmospherics on 27 kc/s channels, and a moderate geomagnetic storm. D.R.Barber

523.775

5589. EMISSION-LINE POLARIZATION IN PROMINENCES.
G.Newkirk, Jr.
Publ. Astron. Soc. Pacific, Vol. 70, 185-90 (April, 1958).

A photoelectric polarimeter (the K-coronameter) was used to study polarization of the emission from the He D3 line in solar prominences. The emission component is separated from the continuous background radiation by an isolating interference filter which can be tilted through 20° to shift its transmission-band centre from line to continuum. D.R.Barber

523.852

5590. ELECTRON DENSITIES IN FILAMENTARY NEBULAE.
D.E.Osterbrock.
Publ. Astron. Soc. Pacific, Vol. 70, 180-4 (April, 1958).

Using as criteria the [O II] 3729 A/3726 A intensity-ratio values at a number of points in the Cygnus loop the mean electron density computed by the formula of Seaton and Osterbrock (1957), is 200 cm^{-3}. Assuming the material of the filament to be chiefly ionized H of density 3.3×10^{-22} gm cm^{-3}, the mass of a cylindrical filament, length 1 parsec and diameter 10^{-3} parsec, is approx. 2.0×10^{-4} mass$_\odot$. D.R.Barber

523.877

5591. ON THE OSCILLATIONS OF A GASEOUS STAR POSSESSING A WEAK MAGNETIC FIELD. P.Ledoux and R.Simon.
Ann. Astrophys., Vol. 20, No. 5, 185-95 (1957). In French.

The fundamental equations for gravitational and magneto-hydrodynamic oscillation of a star are compared, and the degeneracy of the problem is stated. By the use of perturbation theory, it is shown that the oscillation frequencies can be calculated for a star with a weak magnetic field, the degeneracy for non-radial oscillations being reduced by the presence of the field. Some special cases, such as the force-free field and the uniform field, are discussed in more detail. The relative perturbation of the frequency is proportional to the radio of the magnetic to the gravitational potential energy.

M.W.Ovenden

523.877 : 538.11

5592. MOTION OF CHARGED PARTICLES IN A FORCE-FREE MAGNETIC FIELD. D.G.Wentzel.
Astrophys. J., Vol. 126, No. 3, 559-64 (Nov., 1957).

In a force-free magnetic field (curl H = αH) with axial symmetry and α = constant, charged particles are constrained to move around a line of force, and in the guiding-centre approximation no particles can escape from a region with one value of α into another; in particular, cosmic rays cannot escape a stellar or nebular system involving such a field. This result is independent of the energy of the particle and of the complexity of the field. A constant of motion, taking into account radiation losses, is found to be $v_\perp^2/H$. A.

525.21 : 536.212.3

5593. THERMAL HISTORY OF THE EARTH WITH CONSIDERATION OF THE VARIABLE THERMAL CONDUCTIVITY OF ITS MANTLE. H.A.Lubimova.
Geophys. J., Vol. 1, No. 2, 115-34 (June, 1958).

Data about the abundance of the radioactive elements and the thermal conductivity of the earth are in favour of the view that its initial temperature T (r) must have been below the melting temperature. The results of the calculations of T (r) are presented for the earth considered as being formed through accumulation of particles of a gas-dust protoplanetary cloud. The redistribution of radioactive elements from uniform distribution to a layered one is considered. The matter of the mantle is considered as a dielectric possessing not only molecular conductivity but a radiative transfer of heat in the high-temperature range. The Green's function method and hydraulic analogy method are used for the calculations of the solution of the thermal conductivity equation. It is shown that the thermal conductivity due to a radiative transfer of energy at a great depth does not produce any essential losses of inner heat. The thermal conductivity of the earth's upper layers is largely determined by its molecular component decreasing as the temperature rises and thereby forbidding considerable losses of inner heat. That leads to the conclusion that the earth's thermal history may be regarded as secular heating of its interior with simultaneous slight cooling of its outer layers. A.

525.3 : 523.164.42 : 621.396.946

5594. THEORETICAL ANALYSIS OF DOPPLER RADIO SIGNALS FROM EARTH SATELLITES. W.H.Guier and G.C.Weiffenbach.
Nature (London), Vol. 181, 1525-6 (May 31, 1958).

Each ballistic orbit produces a unique time dependence of Doppler frequency shift, assuming no atmosphere and perfect instrumentation. The effect is analysed and the results shown to agree with other orbit estimates of Sputnik I and Explorer I. It is suggested that two or more receiving stations, widely separated but near the orbit, with their results combined simultaneously in a least-squares fit, should serve as a useful measuring system for tracking satellites. C.A.Hogarth

525.3 : 523.164.42

5595. RECEPTION OF RADIO SIGNALS FROM THE SATELLITE SPUTNIK I. P.F.Checcacci, V.Russo and C.Carreri.
Ricerca sci., Vol. 27, No. 11, 3252-60 (Nov., 1957). In Italian.

The apparatus and the methods are briefly described. The pulse signals were recorded, and then examined with an oscilloscope. The oscilloscope patterns are shown, as well as the signal records. When the pulses ceased and a continuous wave was sent, the variations of the radial velocity were evaluated from Doppler's effect. A.

525.624

5596. SOLAR ACTIVITY AND ATMOSPHERIC TIDES.
B.Haurwitz, J.London, G.M.Sepúlveda and M.Siebert.
J. geophys. Res., Vol. 62, No. 3, 489-91 (Sept., 1957).

An attempt has been made to correlate the solar semidiurnal oscillation, and also the lunar semidiurnal tide, with solar parameters. Data for Manila and Batavia have been correlated with the Zurich relative sunspot number, and a lag correlation was also studied. No significant correlation was found. J.M.Hough

PHYSICS

FUNDAMENTALS

530.12 : 531.18

5597. SPECIAL RELATIVITY FOR PHYSICISTS.
G.Stephenson and C.W.Kilmister.
London. Longmans Green (1958) 108 pp.

This book is written for experimental physicists and honours physics degree students. The theory is developed without the use of the tensor calculus, with mathematics limited to the three-dimensional vector analysis. A large number of specific applications to classical and modern physics is included.

530.12

5598. THE RESOLUTION OF THE CLOCK PARADOX.
H.Dingle.
Austral. J. Phys., Vol. 10, No. 3, 418-23 (Sept., 1957).

530.12

5599. THE CLOCK-RETARDATION PROBLEM. G.Builder.
Austral. J Phys., Vol. 10, No. 3, 424-8 (Sept., 1957).

530.12 : 531.51

5600. ON THE EQUATIONS OF MOTION OF ROTATING MASSES IN THE GENERAL RELATIVITY THEORY. A.P.Ryabushko.
Zh. éksper. teor. Fiz., Vol. 33, No. 6(12), 1387-95 (1957). In Russian.

A system of n rotating spherically symmetrical gravitating bodies of infinitesimal dimensions is considered. A comparatively simple derivation is given of relativistic equations of translational and rotational motion for such a system. Infeld's idea of introducing δ-functions into the energy—momentum tensor is used. A.

530.12 : 531.51

5601. A PROPERTY OF EMPTY SPACE-TIME.
L.Ó Raifeartaigh and J.L.Synge.
Proc. Roy. Soc. A, Vol. 246, No. 1246, 299-300 (1958).

Let V_4 be empty space-time, so that $R_{mn} = 0$ throughout V_4. It is shown that if V_4 contains a smooth non-null 3-space V_3 on which the gravitational field vanishes ($R_{rmns} = 0$ on V_3), then the gravitational field vanishes everywhere ($R_{rmns} = 0$ throughout V_4). A.

530.12

5602. PHOTONS, GRAVITONS AND THE COSMOLOGICAL CONSTANT. A.Peres.
Nuovo Cimento, Vol. 8, No. 4, 533-8 (May 16, 1958).

An attempt is made to solve Maxwell equations in a Riemannian space subjected to $R_{ik} = \Lambda g_{ik}$. It is shown that the equation of motion for an electromagnetic wave-packet is similar to that of a particle (photon) having rest mass $(\hbar\sqrt{\Lambda}/c)$. The author then deals with the equation $R_{ik} = \Lambda g_{ik}$ itself, and seeks for a solution having the form of gravitational waves. It is found that, if such waves can carry quanta of energy, then the rest mass of an elementary wave packet (a graviton) is $(\hbar\sqrt{-2\Lambda}/c)$. It may therefore be concluded that Λ cannot be negative, and if gravitons do exist, it can also not be positive. It is therefore necessarily zero, and the rest masses of photons and gravitons are also null. A.

530.12 : 530.145 : 538.3

5603. THE THEORY OF RELATIVITY, THE ELECTROMAGNETIC THEORY AND THE QUANTUM THEORY.
H.T.Flint and E.M.Williamson.
Nuovo Cimento, Vol. 8, No. 5, 680-98 (June 1, 1958).

It is shown how it is possible, by means of geometry and the introduction of a principle of measurement, founded by analogy with the theory of H.Weyl, to discover a unity existing between gravitational, electromagnetic and quantum phenomena. Dirac's equation and an extension of it are derived from the principle of measurement, and an essential feature of the theory is that it incorporates a theory of the electron in which its mass appears as a geometrical quantity, entering into the equation as a consequence of the existence of a fundamental unit of length. The observed mass is given by this geometrical mass together with interaction terms which also enter naturally into the theory. A.

530.12 : 538.3

5604. ALGEBRAIC STUDY OF THE ELECTROMAGNETIC TENSOR IN THE PRESENCE OF INDUCTION.
L.Mariot and Pham Mau Quan.
C.R. Acad. Sci. (Paris), Vol. 246, No. 21, 3018-20 (May 28, 1958).
In French.

An extension of previous work (Abstr. 3673/1958) with special reference to singular fields. R.A.Newing

530.12

5605. ON THE DISCONTINUITIES OF THE CURVATURE TENSORS IN EINSTEIN'S UNIFIED THEORY. S.I.Husain.
C.R. Acad. Sci. (Paris), Vol. 246, No. 21, 3020-2 (May 28, 1958).
In French.

The investigation is concerned with the 1950 formulation of the theory and is based on methods introduced by Lichnerowicz (Abstr. 3674/1958). R.A.Newing

530.12

5606. A STUDY OF EINSTEIN'S EQUATIONS OF UNIFIED FIELD. R.S.Mishra.
Nuovo Cimento, Vol. 8, No. 5, 632-42 (June 1, 1958).

Einstein revised his equation of unified field theory of relativity without assuming any a priori given condition. He considered these equations as more transparent than the previous ones. These equations will be studied and solved in tensorial form in a series of papers. In this paper, which is the first of the series, the form of the solution of the first system of equations is obtained and it is shown that the linearized forms of these equations is the same as those of previous ones. Another set of field equations is also obtained and studied on the same lines. A.

530.12

5607. ON SPHERICALLY SYMMETRIC SOLUTIONS IN MOFFAT'S UNIFIED FIELD THEORY. R.P.Kerr.
Nuovo Cimento, Vol. 8, No. 6, 789-97 (June 16, 1958).

The complete spherically symmetric solution for Moffat's (Abstr. 3688/1958) complex-symmetric field theory is calculated. It is found that the solution is not a unique function of the boundary conditions, even when four coordinate conditions are adjoined to the field equations. Consequently, it is necessary to add four more field equations to those that Moffat assumed. The solution is found when these are generalized de Donder conditions. A.

530.12 : 531.31

5608. GENERALIZED HAMILTONIAN DYNAMICS. P.A.M.Dirac.
Proc. Roy. Soc. A, Vol. 246, No. 1246, 326-32 (1958).

The author's procedure for passing from the Lagrangian to the Hamiltonian when the momenta are not independent functions of the velocities is put into a simpler and more practical form, the main results being obtained by a direct solution of the equations provided by the consistency requirements. It is shown how, under certain conditions, one can eliminate some of the degrees of freedom and so make a substantial simplification in the Hamiltonian formalism. A.

530.12 : 531.31 : 531.51

5609. THE THEORY OF GRAVITATION IN HAMILTONIAN FORM. P.A.M.Dirac.
Proc. Roy. Soc. A, Vol. 246, No. 1246, 333-43 (1958).

The author's generalized procedure for putting a theory into Hamiltonian form (see preceding abstract) is applied to Einstein's theory of gravitation. It is shown that one can make a change in the action density, not affecting the equations of motion, which causes four of the ten degrees of freedom associated with the ten $g_{\mu\nu}$ to drop out of the Hamiltonian formalism. This simplification can be achieved only at the expense of abandoning four-dimensional symmetry. In the weak field approximation one can make a Fourier resolution of the field quantities, and one then gets a clean separation of those degrees of freedom whose variables depend on the system of co-ordinates from those whose variables do not. There are four of the former and two of the latter for each Fourier component. The two latter correspond to gravitational waves with two independent states of polarization. One of the four former is responsible for the Newtonian attraction between masses and also gives a negative gravitational self-energy for each mass. A.

530.12 : 531.51 : 530.145

5610. ON THE POSSIBILITY OF THE CHARGE DEPENDENT CORRECTION TO THE GRAVITATIONAL FORCES. M.Kawaguchi.
Nuovo Cimento, Vol. 8, No. 3, 506-7 (May 1, 1958).

Do Fermi interactions produce observable corrections to gravitational forces? This question is answered in the negative, because in the cases considered the Fermi potential falls off faster than 1/r at large distances. J.C.Taylor

530.145

5611. ATTEMPT TO RELATE THE HEISENBERG EQUATION AND THE EQUATION OF THE WAVE u IN THE THEORY OF THE DOUBLE SOLUTION. L.de Broglie.
C.R. Acad. Sci. (Paris), Vol. 246, No. 14, 2077-9 (April 9, 1958).
In French.

The author seeks to relate the two equations by using the idea of a chaotic sub-quantum medium, proposed by Bohn and Vigier. P.M.Davidson

530.145

5612. RIGHT–LEFT ASYMMETRY AND TWO-COMPONENT NEUTRINO. T.Takabayasi.
Nuclear Phys., Vol. 7, No. 3, 237-50 (June [3], 1958).

The two-component neutrino theory is formulated irrespectively of the handedness of the coordinate frame. This is made possible by introducing a constant pseudoscalar η_f and by ascribing to the two-component spinor slightly new transformation properties under Lorentz transformations. The method automatically exhibits the reflection properties of the various physical quantities of the system and eliminates some confusing inconveniences of the current theory, which restricts one to either right-handed or left-handed coordinate frame. It is emphasized that η_f is an effective instrument in specifying the description of any objectively right–left asymmetrical process. A.

530.145 : 530.12

5613. DIRAC MATRICES, TELEPARALLELISM AND PARITY CONSERVATION. H.S.Green.
Nuclear Phys., Vol. 7, No. 4, 373-83 (July [1], 1958).

This paper puts on a more fundamental basis a proposal of Green and Hurst (Abstr. 5212/1958) for reconciling failures of parity conservation. It is shown that teleparallelism is a necessary consequence of the introduction of Dirac matrices in general relativity, and that these matrices require a reducible 8-dimensional representation. A suggestion is made for the representation of all fermion fields by a single spinor. The problem of particle–antiparticle conjugation is solved for general relativity. Finally it is shown how the formalism introduced by Green and Hurst, and Watanabe (Abstr. 8391/1957) is contained in the theory. A.

530.145

5614. DISCUSSION OF EXPERIMENTAL PROOF FOR THE PARADOX OF EINSTEIN, ROSEN, AND PODOLSKY. D.Bohm and Y.Aharonov.
Phys. Rev., Vol. 108, No. 4, 1070-6 (Nov. 15, 1957).

A brief review of the physical significance of the paradox of Einstein, Rosen and Podolsky (1935) is given, and it is shown that it involves a kind of correlation of the properties of distant non-interacting systems, which is quite different from previously known kinds of correlation. An illustrative hypothesis is considered which would avoid the paradox, and which would still be consistent with all experimental results that have been analysed to date. It is shown, however, that there already is an experiment whose significance with regard to this problem has not yet been explicitly brought out, but which is able to prove that this suggested resolution of the paradox (as well as a very wide class of such resolutions) is not tenable. Thus, this experiment may be regarded as the first clear empirical proof that the aspects of the quantum theory discussed by Einstein, Rosen and Podolsky represent real properties of matter. A.

530.145

5615. THE FUNCTIONAL INTEGRALS IN QUANTUM THEORY. T.Kanki, K.Murata and S.Sunakawa.
Progr. theor. Phys., Vol. 17, No. 1, 7-18 (Jan., 1957).

Matthews and Salam (Abstr. 7682/1955) expressed the propagator of the interacting fields as a functional integral by using the Feynman principle of the "sum over histories". However, when concerned with the boundary condition of the propagator and the definition of the functional integrals, their treatment seems somewhat unsatisfactory. The reason why they obtained the correct results in spite of the existing defects is discussed. A.

530.145 : 539.165.2

5616. A POSSIBLE CHECK OF THE "COMBINED PARITY" CONSERVATION FOR BETA-INTERACTION. A.Z.Dolginov.
Zh. éksper. teor. Fiz., Vol. 33, No. 6(12), 1363-70 (1957).
In Russian.

To elucidate the problem concerning the invariance of beta-interaction with respect to time inversion, it is proposed to observe beta–gamma angular correlation in allowed transitions in aligned nuclei. Formulae were obtained for a beta–gamma correlation for nuclei oriented by different methods. The analysis is carried out for the general type of beta-interaction taking into account non-conservation of parity. An expression is given for beta-gamma angular and polarization correlation for oriented nuclei in the case of beta-transitions of any order of forbiddenness. A.

530.145 : 539.12

PARITY MIXTURES AND DECAY PROCESSES. See Abstr. 5212

530.145 : 539.12

MUON DECAY WITH GENERAL PARITY-NONCONSERVING INTERACTIONS. See Abstr. 5219-20

530.145 : 539.12

WEAK HYPERON DECAY INTERACTIONS UNDER P, C, AND T. See Abstr. 5243

530.145 : 539.166 : 539.165

$\beta-\gamma$ CORRELATION INVOLVING NON-CONSERVATION OF PARITY. See Abstr. 5310

530.145 : 539.165.2

PARITY VIOLATION IN β-DECAY. See Abstr. 5319

530.145

5617. ON A METHOD OF COVARIANT QUANTIZATION. V.Nardi.
Nuovo Cimento, Vol. 8, No. 1, 174-8 (April 1, 1958).

The generalized Poisson brackets defined by Peierls (Abstr. 7934/1952) were evaluated for the in- and out-fields in the case of neutral scalar mesons interacting with nucleons through a non-local interaction (Abstr. 3067/1954). In the latter paper the assumption was made that all the operators of the Fermi and Bose fields are commuting quantities. It is here shown that a result agreeing with that obtained from the canonical method may be obtained without such unusual assumptions for the field operators. One also obtains correct results for the case of pseudoscalar mesons with direct or derivative couplings, and the covariant quantization rules are still consistent if one adds renormalization terms to the equation of motion for the meson-field operator to remove the divergences arising from meson—meson scattering. P.K.Kabir

530.145

5618. CHARGE CONSERVATION IN THE BETHE–SALPETER EQUATION. G.R.Allcock and D.J.Hooton.
Nuovo Cimento, Vol. 8, No. 4, 590-8 (May 16, 1958).

The scalar product between two bound states is expressed in terms of a conserved charge, and reduced to a standard covariant form. A.

530.145

5619. A METHOD OF RENORMALIZATION FOR UNSTABLE PARTICLES. T.Okabayashi and S.Sato.
Progr. theor. Phys., Vol. 17, No. 1, 30-42 (Jan., 1957).

Lee's model is modified in such a way that the V state is in the unstable mass relation. A renormalization is proposed, which reduces to the conventional one in the stable case but is essentially different from the latter in some respects. The result obtained by this method represents the unstability of the V state. However, its decay character is more complicated than the ordinarily accepted exponential time-dependence. New features introduced by this method are discussed. A.

530.145

5620. EXACT DETERMINATION OF A PHENOMENOLOGICAL SEPARABLE INTERACTION. M.Gourdin and A.Martin.
Nuovo Cimento, Vol. 8, No. 5, 699-707 (June 1, 1958).

The method of Muskhelishvili applied by Omnès to the problem of one meson production by mesons is used to solve the integral equation determining a phenomenological separable interaction from the energy dependence of an experimental phase-shift in a collision problem. The interaction in momentum space is given by an expression containing only one integral. The results obtained in a previous paper concerning the existence and multiplicity of the solutions are confirmed (see Abstr. 493/1958). The method is checked by an explicit calculation in the case when the phase shift is exactly given by the shape independent approximation. A.

530.145

5621. MASS REVERSAL AND LEPTON PROCESSES. T.Ouchi, K.Senba and M.Yonezawa.
Nuovo Cimento, Vol. 8, No. 5, 708-16 (June 1, 1958).

It is shown that the special mass reversals MR(1) and MR(2) can be applied to Fermi type interactions without internal contradiction in the theory. The selection rules obtained are consistent with the experiments. This suggests taking the universal Fermi interactions as the most probable primary interactions for all the weak interactions. From the mass reversibility of the theory under MR(1), it is concluded that space parity is not conserved in all weak interactions, and all lepton processes must involve at least one neutrino whose mass must be exactly zero. From the requirement of MR(2), either a linear combination of (STP) couplings or a linear combination of (AV) couplings is shown to be allowed. The theory admits an interesting case where one can introduce two neutrinos which can play a similar role as "twin" neutrinos, and baryons are conserved automatically. A.

530.145 : 539.12 : 539.165

5622. ON THE CONSERVATION OF THE LEPTON NUMBER. M.Konuma.
Nuclear Phys., Vol. 5, No. 3, 504-11 (Feb., 1958).

The generalized conservation laws of the lepton numbers are derived from the requirement of invariance under the gauge transformation involving the γ_5 matrix. The lepton processes, especially $\pi-\mu-e$ decay and β-decay, are systematized by means of the conservation law. For the β-decay process the two-component theory of the neutrino is naturally derived. However this is not so in the problem of the $\mu-e$ decay. Various characteristics of these and other lepton processes are discussed in detail. A.

530.145

5623. ON WEAK INTERACTIONS OF ELEMENTARY PARTICLES. B.d'Espagnat.
Nuovo Cimento, Vol. 8, No. 6, 894-98 (June 16, 1958).

A transformation similar to the one proposed by Pauli (Abstr. 8397/1957) is suggested for the description of 4-vector rotations in a Euclidian [4] space. Specializing these rotations to rotations in "M" space in the way described by several authors, one is led to a general description of weak interactions which, though rather similar to the one previously studied, nevertheless presents some significant new features, and seems freer from ad hoc assumptions. A.

530.145

5624. ON SYMMETRIES OF WEAK INTERACTIONS. B.d'Espagnat, J.Prentki and A.Salam.
Nuclear Phys., Vol. 5, No. 3, 447-54 (Feb., 1958).

The $|\Delta I| = \frac{1}{2}$ rule is replaced by a conservation law. This new scheme is practically equivalent to the rule just mentioned (with the possibility of introducing in a natural way some $|\Delta I| = \frac{3}{2}$ admixture). Its main advantage is that it can incorporate lepton interactions. A.

530.145

5625. A TENTATIVE GENERAL SCHEME FOR WEAK INTERACTIONS. B.d'Espagnat and J.Prentki.
Nuclear Phys., Vol. 6, No. 4, 596-612 (April [2], 1958).

A generalized isobaric spin formalism (M space formalism) that automatically conserves charge and can be extended to leptonic interactions, was suggested by Salam and the present authors in an earlier article (see preceding abstract). The detailed application of this formalism to the whole set of presently known decays is here investigated. It is shown that within the framework of this theory there exists at least one choice of weak interactions that does not contradict any known experimental data on hyperon. K-meson, pion and muon decays, or on ordinary β-decays inasmuch as these are compatible with a V—A coupling. In relation to possible modifications of this choice one or two decay modes are mentioned, which might up to now have escaped detection. A.

530.145

5626. REMARKS ON CERTAIN PROPERTIES OF WEAK INTERACTIONS. B.d'Espagnat and J.Prentki.
C.R. Acad. Sci. (Paris), Vol. 246, No. 10, 1505-8 (March 10, 1958). In French.

The authors' model (preceding abstract) of the weak interactions is generalized in ways allowing some possible but not yet observed decay modes. J.C.Taylor

530.145 : 539.165.2

5627. A POSSIBLE THEORY OF WEAK INTERACTIONS. R.Gatto.
Nuclear Phys., Vol. 5, No. 3, 530-43 (Feb., 1958).

A discussion is given of some of the recent experimental results in β-decay, and a possible theory of weak interactions is presented which is able to reproduce most of the results of the two-component theory but allows for the simultaneous presence of S and V in β-interaction without violating time reversal. The theory is based on a generalization of Tiomno's mass reversal. A.

530.145

5628. ON THE UNIVERSALITY OF THE WEAK INTERACTIONS. S.Gotō.
Progr. theor. Phys., Vol. 17, No. 1, 107-23 (Jan., 1957).

The possibility of extending the concept of iso-spin to leptons produced in lepton reactions — K-meson decays ($K_{\mu 2}$, $K_{\mu 3}$ and K_{e3} decays), pion decays, muon decays, β-decays, and nuclear capture of muon — is investigated. If one assigns the iso-spin $\frac{1}{2}$ for muons and electrons, and zero for the neutrinos produced in $K_{\mu 2}$ decays, a suitable selection rule can be found which allows all the well established lepton reactions and forbids all the unwanted ones. This method is applied to K-meson decays in which lepton reactions coexist with boson—boson decays ($\tau \to 3\pi$, $\theta \to 2\pi$). A.

530.145

5629. WHEN DOES A WEAK INTERACTION BECOME A STRONG ONE? D.I.Blokhintsev.
Uspekhi fiz. Nauk, Vol. 62, No. 3, 381-3 (1957). In Russian.

In an earlier paper (Uspekhi fiz. Nauk, Vol. 61, 137, 1957) a strong interaction was defined as the one where, during the time of collision of particles, their energy is concentrated into energy of reaction and not, in particular, into their kinetic energy. Accordingly weak interactions of electrons with μ-mesons and with neutrinos were not discussed. It appears that, in the above sense, such interactions can become strong and a proof of this assertion is given in the present paper. C.R.S.Manders

530.145 : 539.12

5630. ON THE "NEUTRINO CHARGE" IN WEAK AND STRONG INTERACTIONS. M.Konuma, S.Nakamura and H.Umezawa.
Nuclear Phys., Vol. 6, No. 2, 282-6 (March [3], 1958).

It is proposed here to extend the idea of the neutrino charge of the leptons to all the elementary particles. No experiments have been found to contradict the assumption that parity is conserved when the neutrino charge is conserved and that the neutrino charge changes by a constant in any process due to the weak interactions in which the conservation of the parity is violated. It is likely that the neutrino charges of the baryons and mesons can be assigned to be the same as their hypercharges. A.

530.145 : 539.12

POSSIBLE CHARGE PROPERTIES OF WEAK INTERACTIONS. See Abstr. 5211

530.145 : 539.12

UNIVERSAL FERMI INTERACTION. See Abstr. 5223

530.145

5631. SIMPLIFIED DERIVATION OF THE BINARY COLLISION EXPANSION AND ITS CONNECTION WITH THE SCATTERING OPERATOR EXPANSION. A.J.F.Siegert and E.Teramoto.
Phys. Rev., Vol. 110, No. 6, 1232-4 (June 15, 1958).

The binary collision expansion for the density matrix of a system of N particles with pair interaction was derived by Huang, Lee, and Yang by expansion in the interaction and subsequent summation over terms represented by certain classes of diagrams. A simpler derivation is obtained by the use of the $N(N-1)/2$ integral equations which relate the density matrix of the system to the density matrices of systems in which only one pair of particles interacts. Successive substitution of the integral equations into each other yields an expansion which by a trivial additional step becomes the binary collision expansion. The derviation shows also that the binary collision expansion is the Laplace inverse of the coordinate representation of the expansion in terms of scattering operators. A.

530.145

5632. PION DECAY AND POSSIBLE NONLOCAL EFFECTS IN THE THEORY OF FERMI INTERACTIONS. A.Sirlin.
Phys. Rev., Vol. 111, No. 1, 337-42 (July 1, 1958).

Possible nonlocal effects in the theory of Fermi interactions are studied phenomenologically. Under certain simple assumptions, an effective Hamiltonian is derived which reduces to the local $V-A$ interaction in the limit in which the momentum transfer between the two pairs of Fermi particles is very small. For larger values of the momentum transfer, corrective terms appear which may account phenomenologically for the deviations of the ρ value and the ratio $R = (\pi \to e+\nu)/(\pi \to \mu+\nu)$ from the predictions of the local $V-A$ theory. The pion and muon decays are analysed in detail. Other weak processes are briefly discussed. A.

530.145

5633. FIELD THEORY OF DEUTERON EXCHANGE CURRENTS. L.M.Frantz.
Phys. Rev., Vol. 111, No. 1, 346-53 (July 1, 1958).

The influence of pion exchange currents on the thermal capture process $(n + p \to d + \gamma)$ is investigated field-theoretically. The Chew model is used for the pion–nucleon interaction, and perturbation and corresponding renormalization techniques are developed for treating a system containing two dynamic nucleons. The Fock-space state vector is related to the two-nucleon wave-function, and the cross-section is then calculated to order ef^2. The observed cross-section is known to be somewhat larger than that predicted neglecting explicit meson effects, and it is found here that the contribution of the exchange currents is too small and of the wrong sign to account for the discrepancy. A.

530.145

5634. THE SYMMETRY PROPERTIES OF FERMI DIRAC FIELDS. B.Touschek.
Nuovo Cimento, Vol. 8, No. 1, 181-2 (April 1, 1958).

Work of Gürsey's (Abstr. 2778/1958) is generalized. J.C.Taylor

530.145 : 539.12

5635. NON-LOCAL THEORY OF ELEMENTARY PARTICLES. P.Sen.
Nuovo Cimento, Vol. 8, No. 3, 407-16 (May 1, 1958).

It is noted that if elementary particles are described by non-local fields then the principle of conservation of parity is regained. A modified form of a previous model of the internal co-ordinate wave-equation is shown to give satisfactory agreement with the observed mass spectrum, decays and cross-sections of the seven known unstable particles and it predicts the occurrence of more heavy unstable particles. Then a simple one-dimensional model is constructed and it gives the same mass spectrum as before and the original Pais selection rules. A.

530.145

5636. TWO COMPONENTS SPINOR EQUATION. R.Ascoli.
Nuovo Cimento, Vol. 8, No. 3, 501-5 (May 1, 1958).

A non-linear equation for a quantized two component spinor is written down. The Fermi-type interaction is unique. J.C.Taylor

530.145

5637. ON THE CONNECTION OF SPIN WITH STATISTICS. N.Burgoyne.
Nuovo Cimento, Vol. 8, No. 4, 607-9 (May 16, 1958).

The relation between spin and statistics is proved using only the most general assumptions. A.

530.145

5638. PARITY NONCONSERVATION AND THE GROUP-SPACE OF THE PROPER LORENTZ GROUP. E.J.Schremp.
Phys. Rev., Vol. 108, No. 4, 1076-7 (Nov. 15, 1957).

As a means of incorporating isotopic spin into the foundations of the theory of spin $\frac{1}{2}$ particles, a slight modification of the free-particle Dirac equations has previously been proposed, which follows from a consideration of the group-space of the proper Lorentz group (Abstr. 9422/1955). Further considerations of the group-space suggest two additional modifications which may contribute, in a mutually complementary way, toward establishing a new symmetry principle applicable to parity-nonconserving interactions. A.

530.145

5639. QUANTIZATION PROCESS FOR MASSLESS PARTICLES. C.L.Hammer and R.H.Good, Jr.
Phys. Rev., Vol. 111, No. 1, 342-5 (July 1, 1958).

Gives the quantization of the authors' theory (Abstr. 1509/1958) for particles of arbitrary spin and zero mass. An interesting result is that there is a connection between the spin and the statistics of the particles. It is found that the spinor components of a boson/fermion field with integral/half-integral spin commute/anticommute off of the light cone whereas the spinor components of a boson/fermion field with half-integral/integral spin do not. As in the unquantized theory, the two-component neutrino and the photon are special cases. A.

530.145

5640. ON THE QUESTION OF SUPERPOSITION IN INTERNAL STATES OF ELEMENTARY PARTICLES. M.I.Podgoretskiĭ.
Zh. éksper. teor. Fiz., Vol. 33, No. 3(9), 790-1 (1957). In Russian.

Discusses the connection between conservation laws and conservation of internal states of elementary particles, with reference in particular to conservation of strangeness. J.W.G.Wignall

530.145

5641. SUM OVER TRAJECTORIES FOR THE DIRAC EQUATION. G.V.Ryazanov.
Zh. éksper. teor. Fiz., Vol. 33, No. 6(12), 1437-44 (1957). In Russian.

It is shown that, under some assumptions concerning the motion of an electron, the Feynman (Abstr. 3107/1948) sum over trajectories is identical with the propagation function of the Dirac equation. A.

530.145

5642. RELATION BETWEEN DECAY ASYMMETRY AND THE DIPOLE MOMENT OF FUNDAMENTAL PARTICLES. Ya.B.Zel'dovich.
Zh. éksper. teor. Fiz., Vol. 33, No. 6(12), 1488-96 (1957). In Russian.

Proceeding from a simple model of emission of non-relativistic particles, the wave-function of a system is constructed in the coordinate representation for cases of real decay and virtual decay. It is shown that the asymmetry of real decay of a polarized particle depends on the imaginary part of the gradient coupling constant, while the asymmetry of virtual decay and the dipole moment depend on the real part of this constant. Fundamental particles which, in accord with Landau, do not posses a dipole moment, are shown to be similar to enanthiomorphic (optically active) molecules in the Λ-doubled states. A consistent description of particle production is developed in the coordinate representation. A convenient expression for the probability of virtual decay is presented. A.

530.145

5643. THE SOLUTIONS OF THE LOW EQUATION. II. D.B.Fairlie and J.C.Polkinghorne.
Nuovo Cimento, Vol. 8, No. 4, 555-9 (May 16, 1958).

For Pt I, see Abstr. 3720 (1958). The Low equation for a non-relativistic factorizable potential is investigated. The familiar solution for h(k), where h(k) is the scattering amplitude, is obtained directly as a Low equation by proceeding from the eigenstates of the total Hamiltonian to the eigenstates of the free Hamiltonian. The relation between the manifold of solutions of the Low equation for h(k) and the spectrum of the free Hamiltonian is immediate. The zeros of h(k) are the bound state energies of the free Hamiltonian. A.

530.145

5644. ON THE SOLUTIONS OF THE LOW SCATTERING EQUATION IN A SIMPLE MODEL. F.Duimio.
Nuovo Cimento, Vol. 8, No. 6, 826-33 (June 16, 1958).

It is shown that for the Low scattering equation associated with a simple model proposed by Dyson, a unique solution can be found, when a complete set of physical parameters is known. These parameters consist of the energy levels and the "renormalized coupling constants" of the true bound states which explicitly appear in the Low equation, supplemented by the analogous quantities for the possible unstable states (the Glaser—Källen states, in the framework of the Lee model). A.

530.145

5645. THE HIGH ENERGY LIMIT OF THE POTENTIAL SCATTERING. II. RELATIVISTIC KINEMATICS. M.Verde.
Nuovo Cimento, Vol. 8, No. 4, 560-8 (May 16, 1958).

The asymptotic expansions of the scattering amplitude at high energy, obtained in Pt I (Abstr. 9008/1957) for a Schrödinger equation of motion, are extended to the cases of a Dirac and Klein—Gordon particle. The method followed is based on the extension of the so called Gel'fand and Levitan operator which gives a uniform connection of two complete bases in the Hilbert space. A compact expression for the general term of the expansion is found. This allows its evaluation by means of recurrence relations. A.

530.145

5646. ANALYTIC PROPERTIES OF THE SCATTERING MATRIX. T.Regge.
Nuovo Cimento, Vol. 8, No. 5, 671-9 (June 1, 1958).

The discussion of the behaviour of the S-matrix is carried out on the basis of the modern theory of entire analytic functions for S waves and for a spinless particle scattered by a fixed spherical potential. It is shown that many of the properties of Jost's f(k) functions can be derived quite rigorously and simply, from very general theorems. Among them there is a theorem on the existence of infinite zeros of f(k) when the potential decreases fast enough as to make f(k) regular in the whole plane of k. The asymptotic behaviour of the distribution of these zeros is also discussed. A.

530.145 : 539.12

5647. AN INVARIANT REPRESENTATION OF THE SCATTERING MATRIX. V.I.Ritus.
Zh. éksper. teor. Fiz., Vol. 33, No. 5(11), 1264-7 (1957). In Russian.

The scattering matrix S for a reaction of the type $a + b \rightarrow a' + b'$ is expressed by a finite number of spin operators Q_i which are invariant with respect to rotations and reflections. A procedure is given for constructing operators Q_i; their number is determined for reactions with given initial and final spins. The limitations are considered that are imposed on the form and number of operators Q_i by the condition of invariance of the scattering matrix against the time reversal. Examples are given of the representation of S by means of operators Q_i for a number of reactions. A.

530.145

5648. A NOTE ON AN ACAUSALITY TEST. I. D.Ito, S.Minami and H.Tanaka.
Nuovo Cimento, Vol. 8, No. 6, 834-42 (June 16, 1958).

When the microcausality does not hold the error of the dispersion relations is shown to be twice the forward scattering amplitude in the acausal region. Then, the order of magnitude of this acausal region is discussed concerning the discrepancy in π^-—p scattering found by Puppi and Stanghellini. A.

530.145

5649. REMARKS ON A MODEL FOR S-WAVE MESON—NUCLEON SCATTERING. T.Kobayashi and A.Klein.
Nuovo Cimento, Vol. 8, No. 6, 850-5 (June 16, 1958).

In a paper by Lomon (Abstr. 6362/1956) an attempt was made to produce an exact solution of the field theoretic model for S-wave meson—nucleon scattering in which the interaction is the sum of a scalar pair term and of an isotopic spin—orbit coupling. The solution in question is shown to be exact only in the classical limit, i.e. to correspond to the linear or one-meson approximation. It is also shown that the attempt to take the point source limit of the renormalization encounters difficulties similar to those found in the Lee model and in the simple pair theory. A.

530.145 : 539.12

ELASTIC SCATTERING OF DIRAC PARTICLES. See Abstr. 5174

530.145

5650. ON THE INTER-RELATION OF SCALAR AND PSEUDOSCALAR THEORIES. A.Salam.
Nuclear Phys., Vol. 4, No. 5, 687-9 (Nov., 1957).

A general method for transcribing results from charged scalar meson theory into those for pseudoscalar theory is described. J.C.Taylor

530.145 : 539.12

NUCLEON MAGNETIC MOMENT IN CUT-OFF MESON THEORY. See Abstr. 5192

530.145 : 539.12

5651. SCATTERING FUNCTIONS WITH CROSSING SYMMETRY AND THEIR APPLICATIONS TO THE PROBLEMS OF MESON—NUCLEON SCATTERING. Ning Hu.
Nuclear Phys., Vol. 5, No. 1, 1-10 (Jan., 1958).

It is shown that the general form of scattering functions satisfying appropriate crossing conditions are general solutions of the equations of Chew and Low. These scattering functions fall into two classes. In one class they are analytic functions (usually double-valued) of the momentum variable k with only simple poles and zeros, while in the other class they have a line of discontinuity on the imaginary k-axis between $k = -i$ and $k = -i\infty$. A.

530.145

5652. SCATTERING FUNCTIONS WITH CROSSING SYMMETRY: A CORRECTION. Ning Hu.
Nuclear Phys., Vol. 6, No. 4, 545-6 (April [2], 1958).

The conclusion of an earlier paper (see preceding abstract), that the usual dispersion relation is incorrect, is reversed. S.F.Edwards

530.145

5653. A THEOREM ON POTENTIALS WITH HARD CORES. G.H.Derrick.
Nuclear Phys., Vol. 6, No. 2, 287-94 (March [3], 1958).

It is shown for quite general systems of particles that a potential with a hard core gives the same binding energy in the limit of vanishing core radius as the corresponding potential with no hard core at all. A.

530.145

5654. INTEGRAL REPRESENTATIONS OF CAUSAL COMMUTATORS. F.J.Dyson.
Phys. Rev., Vol. 110, No. 6, 1460-4 (June 15, 1958).

An integral representation is found for the matrix element, between given states, of the commutator of two field-operators. The representation makes use of the information derivable from the local commutativity of the operators and from the mass spectrum of the fields. The representation makes use of the information derivable from the local commutativity of the operators and from the mass spectrum of the fields. The representation was discovered by Jost and Lehmann (Abstr. 38/1958) and proved by them for the case of two fields of equal mass. It is here extended to the case of

unequal masses. The mathematical basis of this work is the fact that every function f(q) of a four-vector q, with a Fourier transform f̃(x) which vanishes for space-like x, has a unique extension which is a solution of the wave equation in six dimensions. A.

530.145

5655. AN EQUATION FOR THE GREEN'S FUNCTIONS OF A SYSTEM OF FUNDAMENTAL PARTICLES. V.G.Solov'ev.
Zh. éksper. teor. Fiz., Vol. 33, No. 5(11), 1215-20 (1957). In Russian.

The Green's functions are introduced for fundamental particles. On the basis of Lagrangians describing all strong interactions of mesons and baryons, closed systems of equations were obtained for the Green's functions in variational derivatives with respect to external currents both in three-space and in four-space of isotopic spin. A.

530.145

5656. QUANTUM STATES OF PARTICLES INTERACTING WITH A HARMONICALLY OSCILLATING CONTINUUM WITH AN ARBITRARY COUPLING. II. A CASE OF TRANSLATIONAL SYMMETRY. V.M.Buimistrov and S.I.Pekar.
Zh. éksper. teor. Fiz., Vol. 33, No. 5(11), 1271-6 (1957). In Russian.

For Pt I see Abstr. 2154 (1958). The method developed in Pt I is extended to a case when the system posesses translational symmetry (an outside potential field is absent, the particle is not localized). The lowest energy levels and the wave-functions of the system, are calculated by the variational method. The method is applied to the polaron problem. In the limiting cases of weak and strong coupling of a particle with oscillations, the calculated energy coincides respectively with the precise result of perturbation theory (in the second approximation) and approaches the Feynman's result for strong coupling (Abstr. 3261/1955). A.

530.145

5657. CONNECTION BETWEEN THE HULTHÉN AND KOHN METHODS IN COLLISION THEORY.
Yu.N.Demkov and F.P.Shepelenko.
Zh. éksper. teor. Fiz., Vol. 33, No. 6(12), 1483-7(1957). In Russian.

Various possible direct variational methods for determination of the phase-shifts of the radial wave-function are considered. It is shown that the most natural criterion of quality of the trial function is the condition of consistency of the equations. A comparison of phase-shift results obtained by the Hulthén and Kohn methods and also a check of the integral identity are not independent criteria and in fact reduce to the consistency requirement. It is also shown how the correct value can be chosen from two phase-shift values obtained by the Hulthén method without resorting to comparison with the results of other methods. A.

530.145 : 539.12

5658. APPLICATION OF THE DISPERSION RELATIONS TO DETERMINATION OF BOUND STATES. V.I.Serdobol'skiĭ.
Zh. éksper. teor. Fiz., Vol. 33, No. 5(11), 1268-70 (1957). In Russian.

Dispersion relations for scattering amplitudes are discussed within the framework of non-relativistic theory. It is shown that the energies, parities and certain spectral coefficients characterizing the bound states of a system can be determined on the basis of scattering data. Some characteristics of the deuteron are determined by using the n–p scattering data. A.

530.145

5659. TIME DEPENDENT FORMULATION OF THE COLLISION PROBLEM IN QUANTUM MECHANICS. L.Eisenbud.
J. Franklin Inst.,Vol. 261, No. 4, 409-20 (April, 1956).

A time-dependent description of the problem, more closely resembling an actual experimental situation, is given, and from an examination of the restrictions that arise, the conventional stationary collision theory is justified. G.H.Burkhardt

530.145

5660. THE SCATTERING OF A PARTICLE BY A COMPLEX BOUND SYSTEM. J.Yvon.
Nuclear Phys., Vol. 5, No. 1, 150-66 (Jan., 1958). In French.

This paper develops a new form of the quantum theory of scattering. It is applicable to electromagnetic waves, and to all types of particles, including neutrons, provided the wave equation which they satisfy is known, together with the wave equation satisfied by the scattering body, and the potential function expressing their interaction. The scattering body is, in general, a complex macroscopic structure. The character of the scattering is studied for the case when the scattering body is in a specified quantum state, and also for the case when it is in a state of thermodynamic equilibrium. P.M.Davidson

530.145

5661. BOUND STATES OF A MANY-PARTICLE SYSTEM. F.Coester.
Nuclear Phys., Vol. 7, No. 4, 421-4 (July [1], 1958).

Rigorous formal solutions of the bound-state Schrödinger equation are constructed in terms of an arbitrary complete set of single-particle wave-functions. From these solutions one sees without effort that the Rayleigh–Schrödinger perturbation expansion of the energy does not contain matrix elements represented by products of unlinked diagrams. The components of the state vector are related in a simple manner to functions represented by linked diagrams only. A.

530.145

5662. THEORY OF DECAY OF A QUASI-STABLE STATE. L.A.Khalfin.
Zh. éksper. teor. Fiz., Vol. 33, No. 6(12), 1371-82 (1957). In Russian.

Some general problems relating to the theory of decay of quasi-stable states are considered. This theory has applications in α-decay, passage of charged particles through potential barriers, nuclear energy level calculations etc. Dispersion relations are derived on basis of semi-finiteness of the energy distribution density ω(E). A criterion of physical feasibility in decay theory is formulated and investigated on basis of Paily and Wiener's theorem. It is shown that an exponential decay law cannot hold for all Γt/ħ. Corrections to the exponential decay law are computed under the simplest assumptions. Dispersion relations between the modulus and phase of the function p(t) are derived and investigated. If the decay law i.e. function | p(t) | is known, these relations permit one to determine analytically the energy distribution density ω(E). The results obtained are derived from general laws of quantum mechanics and are independent of the model of the decaying system. A.

530.145 : 539.12

NEW WAVE EQUATIONS FOR ELEMENTARY PARTICLES.
See Abstr. 5168

530.162

5663. NON-LINEAR IRREVERSIBLE THERMODYNAMICS OF BROWNIAN MOTION. H.C.Brinkman.
Physica, Vol. 24, No. 6, 409-14 (1958).

Irreversible thermodynamics is studied for a special system far from equilibrium. Kramers' theory of Brownian motion leads to a diffusion equation in phase space. The distribution function resulting from this equation is used for the definition of free energy as a function of time. A system of non-linear irreversible thermodynamics is developed on this basis. Relations which are analogous to the Onsager relations are found. The formalism appears to be applicable to a much wider class of diffusion equations. For these more general cases also, Onsager's relations appear automatically, while microscopic irreversibility has not been introduced explicitly. A.

530.162

5664. TRIPLE POINTS OF BROWNIAN PATHS IN 3-SPACE. A.Dvoretzky, P.Erdös, S.Kakutani and S.J.Taylor.
Proc. Cambridge Phil. Soc., Vol. 53, Pt 4, 856-62 (Sept., 1957).

A detailed proof is given that, with probability 1, Brownian paths in 3-dimensional space have no triple points. The method of proof is to show that the set of double points has sigma-finite linear measure and therefore zero capacity, with probability 1. M.J.Kearsley

530.162

5665. QUANTUM STATISTICS OF INTERACTING PARTICLES; GENERAL THEORY AND SOME REMARKS ON PROPERTIES OF AN ELECTRON GAS. E.W.Montroll and J.C.Ward.
Phys. of Fluids, Vol. 1, No. 1, 55-72 (Jan.-Feb., 1958).

A systematic generalization of the Mayer cluster integral theory is developed to deal with the quantum statistics of interacting particles. The grand partition function appears in a natural way and the cluster integrals are integrals over propagators which are derived from the Green's function solution of the Bloch equation (which follows from the Schrödinger equation by replacing it/ħ by $\beta = 1/kT$). Every cluster integral can be represented by a hybrid of a Mayer graph and a Feynman diagram in (β,r) space. The generalization of classical ring cluster integrals is analysed. It is shown that in the case of the electron gas the classical limit of the contribution of these integrals to the grand partition function yields the Debye–Hückel theory while the low temperature limit leads to the Gell-Mann–Brueckner equation for the correlation energy of the ground state. A prescription is given for the construction of the cluster integral associated with any given diagram. A.

530.162 : 530.145

5666. A MODEL OF A NON-IDEAL FERMI GAS.
A.A.Abrikosov and I.M.Khalatnikov.
Zh. éksper. teor. Fiz., Vol. 33, No. 5(11), 1154-9 (1957). In Russian.

The energy of the ground state and the effective mass of excitations were found for a non-ideal Fermi gas with short-range forces, the radius of action of which is small in comparison with the average wavelength. A.

MECHANICS OF SOLIDS

531.224.4

5667. ON THE BUCKLING OF AN ELLIPTIC PLATE WITH CLAMPED EDGE. II. Y.Shibaoka.
J. Phys. Soc. Japan, Vol. 12, No. 5, 529-32 (May, 1957).

For Pt I, see Abstr. 3020 (1957). The buckling of a uniform thin elliptic plate with clamped edge is dealt with in the case where its periphery is subject to a uniform normal pressure in the plane of the plate, and the relationship between the critical buckling load and the eccentricity of the elliptic plate is shown graphically. A.

531.25 : 535.55

5668. A PHOTOELASTIC TECHNIQUE FOR STRAIN MEASUREMENT ON FLAT ALUMINIUM ALLOY SURFACES.
H.Fessler and D.J.Haines.
Brit. J. appl. Phys., Vol. 9, No. 7, 282-7, 278-9 (July, 1958).

A technique is described for bonding layers of an epoxy resin on flat aluminium alloy surfaces. Joints, which withstood more than 1% strain, were obtained by carefully controlled preparation of the metal and the adhesive. Initial birefringence was avoided by curing the joint without external pressure and by slow cooling after finish curing at 65°C. The different types of reflection polariscope are discussed, and the strain-fringe-values for the reflecting layer and for the adhesive are estimated. The test of a lug illustrates an application of the method. A.

531.31 : 530.12

GENERALIZED HAMILTONIAN DYNAMICS. See Abstr. 5608

531.51 : 531.31

THEORY OF GRAVITATION IN HAMILTONIAN FORM. See Abstr. 5609

531.55

5669. UNIVERSAL GRAVITY TURN TRAJECTORIES.
G.J.Culler and B.D.Fried.
J. appl. Phys., Vol. 28, No. 6, 672-6 (June, 1957).

One of the simplest trajectory programmes for the powered flight of a missile through the atmosphere is the "gravity turn", which results from simply keeping the propulsive thrust always parallel to the vector velocity. However, even for a "point mass" missile, in a uniform gravitational field with constant thrust and no aerodynamic forces, the differential equations for the motion are nonlinear and require numerical integration. To avoid the necessity of doing this computation anew for each missile preliminary design, a method has been found for integrating the equations for the singular case of zero initial velocity. When expressed in terms of appropriate dimensionless variables, the resulting solutions are "universal" in the sense that they constitute a good approximation to any gravity turn with a small, nearly vertical, initial velocity. The solutions depend upon two parameters, the initial thrust to weight ratio η and a parameter k which corresponds to the initial "kick angle" of nonsingular gravity turns. A.

MECHANICAL MEASUREMENTS

531.715.1 : 535.417

5670. THICKNESS MEASUREMENT OF EPITAXIALLY GROWN FILMS. O.S.Heavens and D.C.Pandeya.
Nature (London), Vol. 181, 1394 (May 17, 1958).

The thicknesses of Fe and Ni films grown on a rocksalt substrate were determined by floating the film off the rocksalt on to a glass flat where, by silvering the film edge and using Fizeau fringes, the step-height was measured. The results agreed, within the accuracy of measurement (± 20 A), with those for similar films deposited simultaneously, but directly, on glass. The films were deposited at room temperature and were 130 to 450 A thick. S.Weintroub

531.768

5671. DIRECT METHOD OF ACCELEROMETER CALIBRATION.
J.N.Brennan and J.S.Nisbet.
J. Acoust. Soc. Amer., Vol. 30, No. 1, 41-6 (Jan., 1958).

The method, which uses bonded-wire strain-gauges as a standard, is valid over a very wide frequency range (up to 40 kc/s with present instrumentation). Several examples of its application are discussed. Results show that the method is an easy one to use and that it quickly reveals any deficiencies of accelerometers and their amplifiers, e.g. "droop" resulting from insufficient low-frequency response; overloading of a cathode-follower; loss of high-frequency detail caused by too low a cutoff of the accelerometer filter; "hash" caused by accelerometer resonance, etc. Limitations of the method and evaluation of accuracy also are discussed. This method was found to give a complete picture of the actual operation of the accelerometer and associated circuits quickly and accurately, and the results are easily interpreted. A.

531.787.4

5672. A METHOD OF OBTAINING ACCURATE RELATIVE PRESSURES IN THE RANGE 20 TO 200 mm OF MERCURY.
G A.Bottomley.
J. sci. Instrum., Vol. 35, No. 7, 254-7 (July, 1958).

A refined visual method of accurately setting a mercury surface to a tungsten reference point is described in detail. The technique is applied in a differential manometer system to the establishment of a scale of relative pressures, which is self-consistent to better than two parts in 100 000. A.

MECHANICS OF FLUIDS

532.137

5673. COUETTE VISCOMETER FOR STRUCTURAL VISCOSITY STUDIES. J.Baarli and K.Gussgard.
Rev. sci. Instrum., Vol. 29, No. 7, 642-5 (July, 1958).

A description is given of a rotational viscometer where the velocity gradient can be varied from 0.167 to 250 sec^{-1} for liquids with viscosities around 1 cP. Measurements of the viscosity are made by using an electrostatic system. A discussion of the calibration of the instrument together with an estimation of the error associated with each measurement are given. The total relative error as a function of the velocity gradient for water having a viscosity of 1 cP was determined experimentally. The error at 0.167 sec^{-1} is 13%, decreasing to 1.2% at a velocity gradient of 10 sec^{-1}. A.

532.14 : 532.612.4

5674. DENSITY AND SURFACE TENSION OF DEUTERIUM OXIDE. J.M.Costello and S.T.Bowden.
Research, Vol. 10, No. 8, 329 (Aug., 1957).

A sealed dilatometer was used for the measurement of the density D, and a capillarometer for the surface tension γ, of Norsk deuterium oxide (99.95%) over the temperature range T from 20° to 200°C. The results obtained are stated to be given by

$$D = 1.106 - 3.338 \times 10^{-4}(T - 20) - 2.563 \times 10^{-6}(T - 20)^2;$$
$$\gamma = 72.7 - 1.578 \times 10^{-1}(T - 20) - 2.894 \times 10^{-4}(T - 20)^2 + 3.958 \times 10^{-7}(T - 20)^3.$$

S.Weintroub

532.14.08

5675. METHOD FOR THE RAPID AND PRECISE DETERMINATION OF THE DENSITIES OF LIQUIDS. G.L.Gaines, Jr and C.P.Rutkowski.
Rev. sci. Instrum., Vol. 29, No. 6, 509-10 (June, 1958).

The device is based on Archimedes' Principle, and involves the use of a sensitive quartz spiral as a measuring element. With n-butanol-n-heptane solutions, which were used for calibration, a precision of 1 in the fourth decimal place was obtained. A.

532.511

5676. ON THE TRANSONIC FLOW OF A COMPRESSIBLE FLUID PAST AN AXISYMMETRIC SLENDER BODY AT ZERO INCIDENCE. K.Kusukawa.
J. Phys. Soc. Japan, Vol. 12, No. 4, 401-10 (April, 1957).

The high, subsonic flow past a slender body of revolution placed along the axis of a circular, cylindrical wind-tunnel at zero incidence is discussed. By neglecting the square of the perturbation velocity q'^2 in comparison with q' and the spatial derivatives of q'^2, and by using a certain transformation of the variables involved, the fundamental equation determining the perturbation stream function of this transonic flow can be reduced to an equation that is

formally equal to the fundamental equation of transonic flow past a two-dimensional body placed along the centre line between two, parallel, flat walls. Considering the transonic, similar solution due to von Kármán and the general similarity rule of the axisymmetric transonic flow derived by Oswatisch and Berndt, one can obtain the surface-pressure coefficient of an axisymmetric flow, provided the surface-pressure coefficient of a two-dimensional flow can be found. As an example, the pressure distribution on the surface of a paraboloid of revolution of finite length at Mach number 1 is obtained. A.

532.511

5677. ON THE TRANSONIC FLOW OF A COMPRESSIBLE [INVISCID] FLUID PAST A NEARLY AXISYMMETRIC SLENDER BODY. K.Kusukawa.
J. Phys. Soc. Japan, Vol. 12, No. 4, 411-19 (April, 1957).

The problem is dealt with by dividing the perturbation velocity potential into two parts: one determined by the fundamental equation of an axisymmetric transonic flow, the other by the two-dimensional Laplace's equation in the plane perpendicular to the free-stream velocity vector. As examples of the method the flow past an elliptic paraboloid of finite length is discussed, and the head-drag and the lift coefficients of a paraboloid of revolution of of finite length are obtained. A.

532.513.1

5678. THE FORCES EXPERIENCED BY TWO CIRCULAR CYLINDERS IN A UNIFORM FLOW AT SMALL REYNOLDS NUMBERS. S.Kuwabara.
J. Phys. Soc. Japan, Vol. 12, No. 3, 291-9 (March, 1957).

Using Imai's general method of solving Oseen's two-dimensional equations, the drag and lift coefficients for one of two parallel circular cylinders in a uniform flow at low Reynolds numbers were calculated. The general expressions for these coefficients become very simple when the two cylinders are placed symmetrically with respect to the flow. Numerical calculations were carried out for various values of the parameters. A.

532.513.1

5679. EXPERIMENTAL STUDIES OF THE LIFT ON TWO EQUAL CIRCULAR CYLINDERS PLACED SIDE BY SIDE IN A UNIFORM STREAM AT LOW REYNOLDS NUMBERS. S.Taneda.
J. Phys. Soc. Japan, Vol. 12, No. 4, 419-22 (April, 1957).

The measurements were made (by a lamp, scale and mirror method) at Reynolds numbers from 0.01 to 1.6. The results obtained are as follows: (1) each cylinder experiences a repulsive force; (2) the value of lift coefficient decreases monotonically as the Reynolds number is increased; (3) when the Reynolds number is sufficiently small, the value of the lift coefficient first increases and then decreases as the ratio of the distance between the cylinders to the diameter of the cylinders increases. These results are in good agreement with the theoretical conclusions deduced from Oseen's linearized equations of motion. A.

532.513.1

5680. EXPANSION FORMULAE FOR THE FORCES ACTING ON TWO EQUAL CIRCULAR CYLINDERS PLACED IN A UNIFORM STREAM AT LOW VALUES OF REYNOLDS NUMBER. H.Fujikawa.
J. Phys. Soc. Japan, Vol. 12, No. 4, 423-30 (April, 1957).

Expansion formulae, in powers of Reynolds number R, for the drag and lift acting on one of the cylinders are obtained, correct to the lowest order of R. The coefficients of each term are expressed in power series of a/2h, and obtained as far as the terms of $(a/2h)^4$, where a is the radius of the cylinders and 2h the distance between their centres. A.

532.514

5681. ON THE TWO-DIMENSIONAL COMPRESSIBLE FLOW OVER A THIN SYMMETRIC OBSTACLE WITH SHARP SHOULDERS PLACED IN AN UNBOUNDED FLUID AND IN A CHOKED WIND TUNNEL. K.Kusukawa.
J. Phys. Soc. Japan, Vol. 12, No. 9, 1031-41 (Sept., 1957).

The transonic flow is studied by means of a model flow, in which the flow is assumed to separate from the surface of the body at the shoulder, instead of performing the Prandtl–Meyer expansion. Applying this method to the flow past a finite wedge, and comparing the results with the more accurate solutions derived by Guderley, Cole, Hida and Marschner, it is found that the accuracy of the predicted values of the pressure distribution over the surface, or of the head drag coefficient, is fairly good, but that for the choking Mach number this model gives a value different from that of the real flow. The pressure distributions over the surface of the several symmetric profiles with sharp shoulders are calculated by this method. A

532.514

5682. ON THE COMPRESSIBLE FLOW OVER A SLENDER BODY OF REVOLUTION WITH A FLAT BASE PLACED IN AN UNBOUNDED FLUID AND IN A CHOKED WIND TUNNEL. K.Kusukawa.
J. Phys. Soc. Japan, Vol. 12, No. 9, 1042-8 (Sept., 1957).

The flow is studied by the method of the correspondence between the axisymmetric and the two-dimensional flows. The corresponding two-dimensional flow, which is necessary for evaluating the axisymmetric flow, is given by the model flow method (see preceding abstract). By comparing the pressure coefficient on the surface of a cone at sonic speed (calculated by model flow method) with Yoshihara's result, obtained by the relaxation method, the accuracy of the present method is ascertained. This method is applied to the flow past a body of revolution of finite length with a curved surface. A

532.517

5683. THE STABILITY OF VISCOUS FLOW BETWEEN ROTATING CYLINDERS. S.Chandrasekhar.
Proc. Roy. Soc. A, Vol. 246, No. 1246, 301-11 (1958).

A method of solving the exact characteristic value problem to which a study of the hydrodynamic stability of viscous flow between rotating cylinders leads one, is described. In illustration of the method, detailed numerical results are obtained for the case when the ratio of the radii of the two cylinders is one-half. A.

532.517

5684. EXPERIMENTS ON THE STABILITY OF VISCOUS FLOW BETWEEN ROTATING CYLINDERS. I. TORQUE MEASUREMENTS. R.J.Donnelly.
Proc. Roy. Soc. A, Vol. 246, No. 1246, 312-25 (1958).

Measurements of the hydrodynamic stability of viscous flow between concentric cylinders were made with a small rotating cylinder viscometer. The inner cylinder is rotated and the outer cylinder is freely suspended on a torsion fibre. The onset of instability is characterized by a discontinuity in the measured effective viscosity. The results for the case of a small annular gap between cylinders agree to within 1.3% with the theory for an infinitesimal gap. The results for the case of a wide annular gap agree to within 0.50% with the exact theory given by Chandrasekhar (see preceding abstract). Detailed measurements of the torque above the onset of instability were made in both cases. A

532.517.2 : 541.126

5685. ON THE DIFFUSION OF A CHEMICALLY REACTIVE SPECIES IN A LAMINAR BOUNDARY LAYER FLOW. P.L.Chambré and J.D.Young.
Phys. of Fluids, Vol. 1, No. 1, 48-54 (Jan.–Feb., 1958).

A chemically reactive species is emitted from the surface of a body located in a hydrodynamic flow field where it undergoes a simple isothermal, homogeneous transformation. The analysis given enables one to trace the reaction history of this component in a laminar boundary layer flow which develops over the surface of a body. For illustration the development of a first-order reaction in the neighbourhood of a flat plate is calculated. Two reaction types are considered. In one case the reactant is destroyed; in the other, it is generated. The reaction histories show a number of interesting features which are discussed in some detail. A.

532.517.4

5686. TURBULENT FLASHES. H.Faxén.
Ark. Fys., Vol. 13, Paper 20, 235-6 (1958).

A comment on the transition from toroidal vortices at inlet to a sequence of turbulent "flashes", moving with slightly less than the mean velocity of flow down a pipe of diameter 6-12 mm, with long stretches of laminar flow in between. J.G.Oldroyd

532.517.4

5687. EQUIPARTITION OF ENERGY AND LOCAL ISOTROPY IN TURBULENT FLOWS. M.S.Uberoi.
J. appl. Phys., Vol. 28, No. 10, 1165-70 (Oct., 1957).

Homogeneous turbulence in which $\langle v^2\rangle = \langle w^2\rangle \neq \langle u^2\rangle$ was produced experimentally, where $\langle u^2\rangle$, $\langle v^2\rangle$, and $\langle w^2\rangle$ are the mean-square turbulent velocities in x, y, and z direction, respectively. The decay of turbulence and the energy transfer between $\langle u^2\rangle$ and $(\langle v^2\rangle = \langle w^2\rangle)$ were measured, and it was found that the larger components ($\langle v^2\rangle$ and $\langle w^2\rangle$) are losing more energy due to viscosity than by transfer to the smaller component ($\langle u^2\rangle$). However, $\langle u^2\rangle$ is receiving enough energy by transfer to compensate for its decay and is

n fact slowly increasing. The measurement of mean-square vorti-ity components shows that the turbulence is becoming locally iso-ropic at a faster rate than the equipartition of energy is taking place. n another set of experiments it was found that when approximately sotropic turbulence is subjected to deformation, the three compon-ents of turbulent energy become widely different in magnitude and hat the turbulence is not locally isotropic. This indicates that even it high Reynolds number the deformation in a shear flow may cause nisotropy. The data on the turbulent shear flow near a solid wall confirm this conjecture. The connection of this investigation to urbulent flows in general is discussed. In particular, it follows that neither the turbulent energy nor the small-scale structure of turbu-ence rapidly settles down statistically to quasi-equilibrium.

A.

532.517.4 : 541.126

5688. STATISTICAL BEHAVIOR OF A REACTING MIXTURE IN ISOTROPIC TURBULENCE. S.Corrsin.
Phys. of Fluids, Vol. 1, No. 1, 42-7 (Jan.-Feb., 1958).

Under the restrictions of (a) isotropy in turbulent velocity and concentration fluctuation fields, (b) negligible effect of reaction on fluid motion, and (c) negligible effect of heat of reaction on local reaction rate, equations are deduced for some statistical functions of the concentration of reactant. For a first-order reaction the simplest equations do not differ in general character from those of pure mixing without reaction, but the nonlinear nature of second-order reactions introduces decided differences. Solutions for the decay rates of mean concentration and fluctuations are obtained in some limiting cases and with some simplifying assumptions. The principal hypothesis introduced is that a first-order reaction has no effect on the size structure of the scalar field. A.

532.52 : 621.313.3

5689. A.C. LIQUID METAL PUMPS FOR LABORATORY USE. D.A.Watt.
Atomic Energy Res. Establ. (Harwell) Rep. ED/R1856, 12 pp. (1956).

Two types of single phase a.c. electromagnetic pump for liquid metals are described: a leakage reactance model and a combined pump and transformer. The sodium–potassium alloy test rig is briefly described and methods of pump construction detailed. Test results and curves for pumping NaK alloy at temperatures below 70°C are included, and it is shown that the combined form is the more effective pump. One of these models with a single-loop secondary-winding had a maximum efficiency of 11% with output 10 gal/min at 13 lb/in^2 pressure rise, input 650 W, 9.0-7.5 A at 180-195 V. A maximum pressure rise of nearly 30 lb/in^2 is recorded for the first model of this form. A.

532.525

5690. AN ELECTRICALLY-DRIVEN DISK ATOMIZER FOR HIGH SPEEDS OF ROTATION. D.J.Ryley.
J. sci. Instrum., Vol. 35, No. 7, 237-40 (July, 1958).

Disk speeds ranging from 15 000 to 90 000 rev/min are attained by employing a variable speed d.c. motor–inductor alterator set and supplying the high-frequency output to a special induction motor carrying the disk. The apparatus is designed for continuous use at any speed and several protective devices permit unattended operation. The speed is measured by employing a diametral hole in the high-speed shaft to admit a light beam intermittently to a photocell. The resulting signal is amplified and fed to a standard frequency meter. Disk diameters are 2, 3, 4 and 5 cm. A.

532.525

5691. HYDRODYNAMIC STABILITY OF LAMINAR WAKES. N.Curle.
Phys. of Fluids, Vol. 1, No. 2, 159-60 (March-April, 1958).

A theoretical study of a laminar jet gives for the minimum critical Reynolds number

$$\frac{ab^{-1}}{\nu} = \frac{1}{\nu}\int_0^\infty (u_0 - u)dy = 5.5,$$

the jet velocity-profile being replaced by one of the family

$$a\,\mathrm{sech}^2 by = u_0 - u.$$

The velocity defect in a wake-type profile is symmetrical about the axis y = 0, has a maximum at y = 0, with a point of inflexion at finite y, all of which being satisfied by the above form, it only remains to choose a and b to suit the particular wake profile. Experimental results on jets are greater than theory predicts by a factor of 2.6, and it is here found that if the above equation is multiplied by 2.6 then the calculated value of the critical Reynolds number for the case of the wake behind a flat plate, as well as for that behind a circular cylinder, is well in agreement with experimental values. T.C.Toye

532.59

5692. THE REFLEXION OF LONG WAVES AT A STEP. E.F.Bartholomeusz.
Proc. Cambridge Phil. Soc., Vol. 54, Pt 1, 106-18 (Jan., 1958).

A train of long waves travelling along a canal of depth h_2 encounters a vertical step at which the depth changes to h_1. The wavelength is much greater than h_1 or h_2. The classical long-wave theory where vertical acceleration is neglected is clearly inapplicable, although such a treatment has been given by Lamb. In the present paper the problem is treated rigorously by the linearized theory of surface waves. It is found that although the long-wave method of Lamb fails to describe the details of the motion correctly, his predicted reflection coefficient appears as a first approximation. A.

532.612.4 : 532.14

SURFACE TENSION OF DEUTERIUM OXIDE. See Abstr. 5674

532.613.08 : 537.312.62

5693. MEASUREMENT OF SURFACE TENSION AT THE BOUNDARY BETWEEN SUPERCONDUCTING AND NORMAL PHASES. Yu.V.Sharvin.
Zh. éksper. teor. Fiz., Vol. 33, No. 6(12), 1341-6 (1957). In Russian.

The surface tension between the superconducting and normal phases was determined by measuring the period of a simple laminar structure obtained in a flat sample located in an inclined magnetic field. For a tin single crystal results of the measurements between 2.165 and 3.5°K can be described by a simple formula. A.

532.65 : 534.222.2

5694. FRAGMENTATION OF WATERDROPS IN THE ZONE BEHIND AN AIR SHOCK. O.G.Engel.
J. Res. Nat. Bur. Stand., Vol. 60, No. 3, 245-80 (March, 1958).

Observations made on the fragmentation of two waterdrop sizes, after collision with air shocks that were moving at three different supersonic velocities, are reported. The possible mechanisms of various aspects of the fragmentation process are discussed. The experimental observations indicate that high-speed-rain-erosion damage should not be observed on spheres having a diameter as large as 4 feet and moving with a Mach number in the range of 1.3 to 1.7 in rain that has a drop diameter of 1.4 mm. Waterdrops of this size should be reduced to mist in the zone of separation between the detached shock and the surface of the sphere according to the results that are reported. A means to extend this protection to spheres of smaller diameter or to rain of larger size is pointed out. The need for further experimental observation of the time required for the fragmentation of waterdrops using shocks moving at higher Mach numbers is indicated to verify and extend the information. A.

MOLECULAR THEORY OF LIQUIDS

532.7

5695. DETERMINATION OF THE DISTRIBUTION OF DENSITY OF ATOMS IN LIQUID Al AND Bi FROM ELECTRON DIFFRACTION DATA. A.I.Bublik and A.G.Buntar'.
Fiz. Metallov i Metallovedenie, Vol. 5, No. 1, 53-7 (1957). In Russian.

Previous work (Abstr. 2855/1958) had shown that at temperatures just above the melting point, liquid Sn had a structure such that nearest neighbours were distributed in the same way as in solid Sn but that at higher temperatures the liquid structure changed to one of more dense packing. Electron diffraction patterns obtained by transmission through 200-300 A thick films of Bi gave similar results. With Al, the structure of the solid persisted above the melting point but as the temperature was further raised the packing became less dense. A.F.Brown

532.7

5696. SOLUTION OF THE BLOCH EQUATIONS FOR DETERMINATION OF RELAXATION TIMES IN LIQUIDS. P.S.Hubbard, Jr and T.J.Rowland.
J. appl. Phys., Vol. 28, No. 11, 1275-81 (Nov., 1957).

Describes an experiment on a nuclear spin system whose general behaviour follows the Bloch differential equations. A solution of these is given in which both audio modulation and linear variation of the external magnetic field are explicitly included. For the case of T_1 approximately equal to T_2 and $(\gamma H_1)^2 T_1 T_2 \gg 1$, the solution assumes a simple form which agrees well with experiment. T_1 can

be determined by comparison of the predicted line shapes with those obtained experimentally. A.

532.7

5697. NODAL EQUATION OF STATE AND PHASE TRANSITIONS IN FLUIDS. E.Meeron.
J. chem. Phys., Vol. 28, No. 3, 505-6 (March, 1958).

A new class of expansions of pressure, potentials of average force, and distribution functions is defined in terms of topological modes. Exploitation of the topological aspects of the density power series leads to rapid convergence. It is expected that a fluid with hard-sphere interactions will exhibit phase transitions (see the two abstracts following). P.Gray

532.7

5698. PRELIMINARY RESULTS FROM A RECALCULATION OF THE MONTE CARLO EQUATION OF STATE OF HARD SPHERES. W.W.Wood and J.D.Jacobson.
J. chem. Phys., Vol. 27, No. 5, 1207-8 (Nov., 1957).

The results are in agreement with those obtained from molecular dynamics (see abstract following), and evidence is found for a first-order phase change at between 1.55 and 1.6 times the volume of close-packing. P.Gray

532.7

5699. PHASE TRANSITION FOR A HARD SPHERE SYSTEM. B.J.Alder and T.E.Wainwright.
J. chem. Phys., Vol. 27, No. 5, 1208-9 (Nov., 1957).

The equation of state is obtained by calculation of the molecular dynamic motion for a system of particles in a box, and shows two overlapping branches. Of these, the higher (pressure) corresponds to free intermingling, and the lower to motion-in-a-cell, of the particles. P.Gray

532.7 : 533.7

5700. A NEW FUNCTION IN THE THEORY OF FLUIDS AND AN EQUATION OF STATE FOR LIQUIDS AND GASES. A.G.McLellan.
Phil. Mag. (Eighth Ser.), Vol. 3, 707-14 (July, 1958).

A hole theory of fluids is described in which the potential of a molecule in a cell is not assumed to be spherically symmetric about the cell centre. Although this theory is incomplete in several respects, it has lead to the discovery of a function of pressure, density and temperature which when evaluated for real fluids, such as argon and krypton, appears to be a function of density only, and independent of the state, liquid or gas. It is shown how this property would lead to an equation of state valid for liquid and gas, and the results of a first attempt in this direction are given, which are in better agreement with experiment than those of other lattice or hole theories. A.

532.7 : 533.7

5701. THE NON-EQUILIBRIUM PAIR DISTRIBUTION FUNCTION AT LOW DENSITIES. M.S.Green.
Physica, Vol. 24, No. 6, 393-403 (1958).

Discrete collisions of not more than three particles are treated in the present approximation. The pair distribution function (d.f.) is calculated as a convergent series in powers of the concentration, each term of which involves Ursell—Mayer functions. A transformation is introduced which shows that the pair d.f. is a function only of the single d.f. P.Gray

532.7 : 533.7

5702. A REMARK ON THE TIME-DEPENDENT PAIR DISTRIBUTION. L.van Hove.
Physica, Vol. 24, No. 6, 404-8 (1958).

After recalling the classical work of Zernike and Prins on the pair distribution function of a liquid or gas and its role in X-ray scattering theory, the time-dependent generalization of this function is briefly discussed, which is of special interest for neutron scattering. In line with an earlier result of Fano, it is shown that the imaginary part of the time-dependent pair distribution directly describes the local density change produced in a liquid or gas by the presence of a neutron. A.

532.7 : 536.48

5703. OSCILLATIONS OF A FERMI LIQUID IN A MAGNETIC FIELD. V.P.Silin.
Zh. éksper. teor. Fiz., Vol. 33, No. 5(11), 1227-34 (1957).
In Russian.

Spin oscillations of a paramagnetic Fermi liquid (He^3) placed in a constant magnetic field are considered at low temperatures when it is possible to disregard collisions. A.

532.7 : 539.19 : 534.23

MOLECULAR RELAXATION PROCESSES IN LIQUIDS. See Abstr. 4803

532.7 : 534.22 : 535.43

SCATTERING OF LIGHT AND DISPERSION OF SOUND IN LIQUIDS. See Abstr. 4905

532.7 : 539.12

SCATTERING OF SLOW NEUTRONS BY A LIQUID. See Abstr. 5205

532.77 : 541.12.01

5704. INVESTIGATION OF PHASE EQUILIBRIA IN A PART OF THE SYSTEM H_2O—SiO_2—Na_2CO_3 AT HIGH TEMPERATURES AND PRESSURES. V.P.Butuzov and L.V.Bryatov:
Kristallografiya, Vol. 2, No. 5, 670-5 (1957). In Russian.

The solubility of quartz in aqueous solutions of sodium carbonat is determined at high temperatures (300-400°C) and pressures (up to 1500 atm). The conditions under which the solution separates into a heavy phase (35-50% SiO_2) and a light phase (up to 3% SiO_2) are also determined. R.F.S.Hearmon

MECHANICS OF GASES

533.11.08 : 537.562

5705. MEASUREMENT OF LOW VAPOUR CONCENTRATIONS BY COLLISION WITH EXCITED RARE GAS ATOMS. J.E.Lovelock
Nature (London), Vol. 181, 1460-2 (May 24, 1958).

Describes methods for measuring the concentration of organic vapours in ionization chambers (change in current, etc.) or in certai spark-gap detectors (change in tube voltage, etc.). The vapours are ionized by excited rare-gas atoms, present in quantity, and affect the electrical constants of the apparatus used. J.D.Craggs

533.275 : 551.508.71

5706. A NEW ABSOLUTE METHOD OF HYGROMETRY. I. THE GENERAL PRINCIPLES OF THE METHOD. R.G.Wylie.
Austral. J. Phys., Vol. 10, No. 3, 351-65 (Sept., 1957).

An ionic single crystal is surrounded by the gas which is the subject of measurement, and the temperature of the whole is so adjusted that a very thin layer of saturated solution is formed on the crystal surface and is brought to a constant thickness as determined electrically. The temperature thus established provides a measure of the absolute humidity of the gas. The general principles and theory of the method are dealt with and the observed performance is outlined. The method is compared with the conventional condensatio method, the basic limitations of which are considered, and is shown to be considerably more accurate; it is also more convenient and can be at least as rapid in response. A.

533.275 : 551.508.71

5707. A NEW ABSOLUTE METHOD OF HYGROMETRY. II. THE PROPERTIES OF POTASSIUM CHLORIDE CRYSTAL ELEMENTS. R.G.Wylie.
Austral. J. Phys., Vol. 10, No. 4, 429-53 (Dec., 1957).

For Pt I, see preceding abstract. A detailed experimental inves tigation was made. An explanation of the relevant properties in terms of the structure of the crystal surface is given. This may be used as a basis for predicting the behaviour to be expected of the hygrometer for a wide range of conditions. It was concluded that at ordinary temperatures the method is capable of an absolute accuracy in the equilibrium temperature (or corresponding dew-point) of 0.01 deg. C, is capable of detecting changes in that temperature of 0.002 deg. C, and is capable of a time-constant of as small as 1 sec. In addition to providing direct information on the behaviour of the hygrometer the experiments have revealed fundamental effects of some interest. The most significant of these demonstrate the existence of free energy barriers to crystal growth and crystal dissolution. Evidence has been obtained that the vapour pressure of a layer of saturated solution only 80 A thick does not differ from that of the bulk liquid by more than 0.15%. A.

533.51/.57 : 537.533

5708. VACUUM EQUIPMENT FOR THE 4 MeV LINEAR ELECTRON ACCELERATOR. B.G.Loach.
Atomic Energy Res. Establ. (Harwell), Rep. El/R229, 18 pp. (1956).

The report includes a description of the self-contained pumping tables, and the automatic control equipment. An account is given of development work on the diffusion pumps and vacuum gauges, and the design of high-vacuum shut-off valves. A.

533.52/.54 : 537.534.3

5709. AN OIL-FREE PUMPING SYSTEM. A.H.Turnbull.
Atomic Energy Res. Establ. (Harwell), Mem. GP/M 201, 2 pp.(1957).

A mercury diffusion pump is backed by a water jet pump. The latter is supplied by a centrifugal pump, which circulates the water

round a loop. It was found necessary to cool the water in the circulating system in order to reduce its vapour pressure to an acceptable value. A.

533.59

5710. MAGNETICALLY OPERATED NEEDLE VALVE.
J.O.Cope.
Rev. sci. Instrum., Vol. 29, No. 3, 232-4 (March, 1958).

A solenoid-operated needle-valve is described, which gives smooth and rapid control of gas flow-rates over a wide range from a cut-off value of approximately 10^{-4} micron-liter sec^{-1}. In conjunction with a suitable pressure transducer the valve may be used for the automatic control of pressure in vacuum systems. A.

533.6.011

5711. SOME STATIONARY RELATIVISTIC FLOWS.
K.P.Stanyukovich.
Dokl. Akad. Nauk SSSR, Vol. 119, No. 2, 251-4 (1958). In Russian.

A study of adiabatic stationary symmetrical flows which may be plane, cylindrical or spherical. Solving the equations of motion together with the adiabatic equation of the gas, the critical velocity and asymptotic form of the solution are studied for both a non-relativistic and extreme-relativistic gas. Expressions for the pressure dependence and the velocity of the medium are given. The case of spherical motion in the extreme-relativistic gas obeying the adiabatic law $pv^{4/3}$ = constant is investigated in detail.
M.J.Kearsley

533.6.011.4

5712. SUPERSONIC DRAG OF SPHERES AT LOW REYNOLDS NUMBERS IN FREE FLIGHT. A.May.
J. appl. Phys., Vol. 28, No. 8, 910-12 (Aug., 1957).

Values of the drag coefficient were obtained for spheres in the region $1.5 < M < 3.0$, $350 < Re < 3000$ in the Pressurized Ballistics Range at the Naval Ordnance Laboratory. This region borders, on the low Reynolds number side, one investigated previously. The low Reynolds numbers were obtained by using air pressures of about 7 mm Hg and spheres as small as $\frac{1}{8}$ in. in diameter. A contour map of C_D on Mach number and Reynolds number coordinates has been derived from the experimental data. A.

MOLECULAR THEORY OF GASES

533.7

5713. INTERACTION OF TWO BODIES, "RADIATING" GAS STREAMS. K.P.Stanyukovich.
Dokl. Akad. Nauk SSSR, Vol. 119, No. 4, 686-9 (1958). In Russian.

Two streams of gas at different temperatures will, on intermingling, exchange energy between their molecules (regarded as solid spheres) in such a way as to tend to equalize their temperatures. The effect of this mean energy exchange can, on the molecular scale, be represented by a "radiation" term added to the two-body static interaction. J.W.Gardner

533.7

5714. EMISSION OF RADIATION BY A HOT GAS: EFFECT OF VIBRATIONAL—TRANSLATIONAL ENERGY EXCHANGE.
D.A.Dows.
J. chem. Phys., Vol. 27, No. 6, 1430-1 (Dec., 1957).

A method is suggested for determining collision deactivation lifetimes, τ_0. At low radiation density, depopulation of excited states will occur by radiation, and the population will tend to be maintained by pressure-dependent collision processes. A plot of intensity v. pressure should give a horizontal line at high pressures and have a slope inversely proportional to $\tau_0 A$ at low pressure; A is the Einstein emission coefficient, which can be determined by absolute intensity measurements. A.G.Gaydon

533.7 : 536.23

5715. THERMAL CONDUCTIVITY OF MULTICOMPONENT GAS MIXTURES. E.A.Mason.
J. chem. Phys., Vol. 28, No. 5, 1000-1 (May, 1958).

Kihara's method (Abstr. 4261/1954) applied to the set of simultaneous linear equations results in considerable simplification in the final form; the constants of empirical formulae for simple mixtures are explicit, and temperature and mass dependence for more complex mixtures can be predicted accurately. P.Gray

533.7

5716. CLASSICAL THEORY OF TRANSPORT PHENOMENA IN DILUTE POLYATOMIC GASES. N.Taxman.
Phys. Rev., Vol. 110, No. 6, 1235-9 (June 15, 1958).

A classical theory of transport phenomena in dilute gases of molecules possessing internal degrees of freedom is presented. It is shown that the existence of inverse collisions is unnecessary for the development of the theory. First-order formal expressions for the coefficients of thermal conductivity, shear viscosity, and bulk viscosity are given. In cases where the molecules make only elastic collisions the expressions found reduce to the well-known Chapman—Enskog results. The treatment is very similar to the semiclassical one of Wang Chang and Uhlenbeck, who treated the internal degrees of freedom quantum-mechanically and could thus use the fact that quantum inverse collisions exist. Their theory reduces to the present one in the classical limit. A.

533.7 : 532.7

PAIR DISTRIBUTION FUNCTION IN GASES. See Abstr. 5701-2

533.72 : 535.325

REFRACTIVITY OF GASES AND ITS USE IN CALCULATING VIRIAL COEFFICIENTS. See Abstr. 4850

VIBRATIONS. ACOUSTICS

534.13

5717. WAVES ON THE SURFACE OF A CRYSTAL.
H.Deresiewicz and R.D.Mindlin.
J. appl. Phys., Vol. 28, No. 6, 669-71 (June, 1957).

Surface waves in crystals are investigated for surface orientations and directions of propagation which preclude waves of plane strain. These waves are of importance in the study of very high frequency vibrations of certain crystal plates. It is shown that, in the AT cut of quartz, one and only one surface wave can propagate along the digonal axis. By reduction to the case of orthorhombic symmetry, it is shown that the surface wave is the result of coupling between a surface wave of plane strain and either a face-shear mode or a transverse thickness-shear mode. The former combination is associated with flexural and the latter with extensional vibrations of AT plates. Computation of the wave velocity requires the simultaneous solution of algebraic equations of the third and fifth degrees as opposed to a single cubic equation in the case of waves of plane strain. A.

534.2

5718. THE EFFECT OF SURFACE IMPERFECTIONS ON THE PROPAGATION OF RAYLEIGH WAVES. I.A.Viktorov.
Dokl. Akad. Nauk SSSR, Vol. 119, No. 3, 463-5 (1958). In Russian.

An experimental investigation of the effect of isolated surface imperfections on the diffusion of Rayleigh waves is made, using three model defects: a crevice in the surface, a semicylindrical groove and a wedge. Measurements of the coefficients of reflection A_r and transmission A_t of the waves were made using pulses of 3 Mc/s frequency and 10 μsec duration. Graphs are given plotting A_r, A_t and $A_r^2 + A_t^2$ against the angle of the wedge, the depth of the cleft in wavelengths and the radius of the semicylindrical groove in wavelengths, respectively. The curves show clear maxima and minima and are discussed in detail. M.J.Kearsley

534.2

5719. ABSORPTION OF RAYLEIGH WAVES IN LOW LOSS MEDIA. F.Press and J.Healy.
J. appl. Phys., Vol. 28, No. 11, 1323-5 (Nov., 1957).

Many materials are characterized by internal dissipation parameter $1/Q \ll 1$. An expression is derived for such media relating the Rayleigh wave absorption coefficient to compressional and shear wave absorption coefficients with the elastic velocities as parameters. Ultrasonic experiments are described in which the three absorption coefficients are measured in thin Plexiglas sheets. The theoretically derived expression satisfactorily relates the observed absorption coefficients. A.

534.2

5720. A METHOD OF INCREASING THE STABILITY OF SOUND AMPLIFYING SYSTEMS. L.N.Mishin.
Akust. Zh., Vol. 4, No. 1, 64-72 (1958). In Russian.

The paper describes a system with acoustic feedback based on continuous change of phase of the feedback. The mathematical principles governing the choice of optimal values of amplitude of phase deviation for certain periodic laws of change of phase are given. The paper also gives some experimental results. C.R.S.Manders

534.22 : 532.7 : 535.434

DISPERSION OF SOUND IN LIQUIDS. See Abstr. 4905

534.221

5721. METHOD OF MEASURING SOUND VELOCITY AMPLITUDE IN [HOLLOW] TUBES OVER THE AUDIO AND NEAR ULTRASONIC RANGE. K.Landecker and K.S.Imrie.
Rev. sci. Instrum., Vol. 29, No. 5, 396-8 (May, 1958).

A conducting quartz fibre was stretched across a cross-section of the tube where the latter was pervaded by the magnetic field of a permanent magnet. The potential difference across the oscillating fibre was recorded on an oscilloscope. Velocity amplitudes were measured for frequencies up to about 20 kc/s. An approximate relation is derived for the velocity amplitude as a function of the generated potential. It was found that the method is much freer from disturbances over the above frequency range than a similar method in which the cooling effect by the sound-wave on a current heated wire of fibre is used. Some observations made during the production of quartz fibres sputtered with gold are reported. A.

534.222.1

5722. AMPLITUDE FLUCTUATIONS OF A SOUND IN A TURBULENT MEDIUM. B.A.Suchkov.
Akust. Zh., Vol. 4, No. 1, 85-91 (1958). In Russian.

Fluctuations of amplitude of a sound spreading in a layer of the atmosphere near the ground were measured. The root-mean-square value of fluctuations appears to vary linearly with distance. A comparison is made of the magnitude of fluctuations obtained directly from acoustic measurements with that calculated from the vertical gradient of temperature and wind velocity. An attempt is made, using the experimental material obtained above, to determine the transverse correlation functions of the acoustic field.

C.R.S.Manders

534.222.2

5723. RAY-THEORY SOLUTION OF THE PROBLEM OF PROPAGATION OF EXPLOSIVE SOUND IN A LAYERED LIQUID.
C.L.Pekeris and I.M.Longman.
J. Acoust. Soc. Amer., Vol. 30, No. 4, 323-8 (April, 1958).

The problem of propagation of explosive sound in a layered liquid is formulated operationally, and an exact solution is derived based on ray theory. The contribution of each ray at a given time is expressed by a single definite integral taken over a fixed finite range. The pressure-field was evaluated both for the case of a slow-speed bottom and for that of a high-speed bottom. It was found that for a Heaviside unit pulse and a high-speed bottom the pressure becomes logarithmically infinite at the time of arrival of the totally reflected wave. For a high-speed bottom, the pressure pulse at large ranges, as computed by the ray theory, exhibits the well-known features of a long-period ground-wave followed by a high-frequency dispersive water-wave. It has been found, furthermore, that at large ranges sufficient accuracy can be obtained by retaining only the contributions from a group of the last arriving quadruplets of rays. With this approximation it becomes feasible to use ray theory for the evaluation of the pressure field even at large ranges.

A.

534.222.2

5724. POSSIBLE EXPLANATION OF "AFTER-JET" BY THE DETONATION OF SHAPED CHARGES. S.Singh.
J. appl. Phys., Vol. 28, No. 11, 1365-6 (Nov., 1957).

Evidence is quoted suggesting that the after-jet is due to the relatively long time taken for the later stages of collapse, because of the low collapse velocity of the lower portion of the cone, and because of the ductile drawing between the rear of the jet and the front of the slug.

H.J.H.Starks

534.222.2

5725. COMMENT ON REFLECTED SHOCK WAVE STUDIES.
R.A.Strehlow and A.Cohen.
J. chem. Phys., Vol. 28, No. 5, 983-5 (May, 1958).

Schlieren photographs show an acceleration and bifurcation of reflected shocks. These result from interaction with the boundary layer, and the bifurcation is greater for gases with low heat capacity ratio, γ. Determinations of dissociation energies and interpretation of the acceleration as vibrational relaxation by Toennies and Greene are criticized.

A.G.Gaydon

534.222.2

5726. WALL EFFECTS IN SHOCK TUBE FLOW.
R.J.Emrich and D.B.Wheeler, Jr.
Phys. of Fluids, Vol. 1, No. 1, 14-23 (Jan.-Feb., 1958).

In order to study wall effects in shock tube flows, measurements were made of shock strength, of average density across the tube, and of pressure at the walls. These measurements are compared with explicit predictions of Trimpi and Cohen and of Mirels and Braun. Under conditions where the theories should apply, they predict shock attenuation and values of the flow variables sufficiently well to justify as essentially correct the assumptions that the turbulent boundary layer produced by the shock is similar to the boundary layer observed in steady flows and that waves generated by wall effects can be considered as one-dimensional. A need for some modification of the theories is indicated, however, by lack of quantitative agreement in certain cases. Considerable mixing of the hot and cold gases is observed to occur. Neither theory attempts to explain the mixing nor takes into account its effects on wave propagation.

A.

534.222.2

5727. EFFECT OF RADIATION ON SHOCK WAVE BEHAVIOR.
R.E.Marshak.
Phys. of Fluids, Vol. 1, No. 1, 24-9 (Jan.-Feb., 1958).

The fundamental conservation equations governing fluid dynamics and including radiation are written down. The Rankine–Hugoniot conditions are derived for shock waves subjected to radiation flux. Similarity solutions are obtained for the constant density and constant pressure cases. Some results are stated for the combined radiation fluid dynamics corresponding to a power law dependence of the temperature on the time.

A.

534.222.2

5728. CALCULATION OF SHOCK HUGONIOTS AND RELATED QUANTITIES FOR NITROGEN AND OXYGEN.
R.A.Alpher and H.D.Greyber.
Phys. of Fluids, Vol. 1, No. 2, 160-1 (March-April, 1958).

The Hugoniots are given as graphs of density ratio against pressure ratio for points behind the shock fronts. A complete report is available on application to the authors, giving details of degrees of dissociation, single and double ionization, and Mach numbers, in addition to the graphical data.

P.Gray

534.222.2 : 536.52

MEASUREMENT OF HIGH TEMPERATURES IN SHOCK WAVES. See Abstr. 4932

534.222.2 : 523.161

SHOCK WAVES IN INTERSTELLAR SPACE. See Abstr. 5580

534.222.2 : 532.65

FRAGMENTATION OF WATERDROPS IN THE ZONE BEHIND AN AIR SHOCK. See Abstr. 5694

534.23

5729. ULTRASONIC ABSORPTION IN CONCENTRATED SUGAR SOLUTIONS. F.R.Flad and R.T.Beyer.
J. chem. Phys., Vol. 28, No. 5, 985 (May, 1958).

Absorption measurements in 20% and 40% sucrose solutions at 18.5, 24.0 and 31.7 Mc/s and between 0° and 50°C do not confirm theoretical predictions of relaxation at 95 Mc/s. Since a numerical error in this theory is reported, the authors conclude that the absorption cannot be described by the proposed "hole" theory of the liquid state.

H.D.Parbrook

534.23

5730. ULTRASONIC ABSORPTION IN SUGAR SOLUTIONS.
G.S.Verma.
J. chem. Phys., Vol. 28, No. 5, 985-6 (May, 1958).

Arguments to suggest that current experimental work does not invalidate the "hole" theory of the liquid state as applied to sugar solutions (see preceding abstract).

H.D.Parbrook

534.23 : 532.7

5731. ON THE THERMODYNAMICAL THEORY OF RELAXATION PHENOMENA IN SYSTEMS WITH ADDITIONAL PARAMETERS.
V.T.Shmatov.
Zh. éksper. teor. Fiz., Vol. 33, No. 6(12), 1359-62 (1957). In Russian.

A thermodynamical theory of relaxation phenomena connected with relaxation of an additional internal parameter of a system is developed on the basis of Mandelshtam and Leontovich's method for acoustic-wave absorption in liquids. The relaxation times and the relationship between them are determined. Expressions for dynamic derivatives were obtained for the case of a periodic perturbation. A relationship is established between the relaxation time and discontinuities of the derivatives near the Curie point. The results are extended to an arbitrary number of additional internal parameters.

A.

534.231

5732. ACOUSTIC FIELD IN A MEDIUM WITH A HOMOGENEOUS SURFACE LAYER. A.N.Barkhatov.
Akust. Zh., Vol. 4, No. 1, 13-18 (1958). In Russian.
The acoustic field is investigated for a space bounded by a surface layer over an extended medium, in which there is a constant negative gradient of the velocity of sound, for various positions of the radiator. The results for geometrical and wave theories are compared. C.R.S.Manders

534.232

5733. GENERATION OF A SOUND PULSE OF A GIVEN SHAPE USING A PIEZOELECTRIC PLATE. Yu.L.Gazaryan.
Akust. Zh., Vol. 4, No. 1, 33-6 (1958). In Russian.
A generalization of D'Alembert's method to the case of piezoelectric media is used for discussing a unidimensional problem of generation of a sound pulse of given shape by means of a piezoplate. C.R.S.Manders

534.232

5734. TWO DESIGNS OF EXPERIMENTAL ACOUSTIC SIRENS. E.P.Mednikov.
Akust. Zh., Vol. 4, No. 1, 59-63 (1958). In Russian.
Two designs of instrument are described, which are intended for experimental work on acoustic coagulation of aerosols and for the study of other processes in gaseous media. C.R.S.Manders

534.232

5735. THE SWELLING EFFECT OF THE VIBRATING PLATE AS STANDARD SOUND SOURCE. K.Ikegaya.
J. Inst. Elect. Commun. Engrs Japan, Vol. 41, No. 2, 144-6 (Feb., 1958). In Japanese.
The sound pressure produced by a vibrating prolate spheroid in the low-frequency range is analysed and that produced by a spherical shell is calculated by applying Rayleigh's formula in the high-frequency range, in order to investigate the effect of using a curved instead of a flat piston as the vibrating element of a standard sound source. See also Abstr. 1570 (1958). A.Wilkinson

534.232

5736. DIRECTIONAL CHARACTERISTICS AND [ACOUSTIC] IMPEDANCE OF AN ARTIFICIALLY-COMPENSATED VIBRATING CYLINDRICAL SOURCE. M.Federici.
Ricerca sci., Vol. 27, No. 6, 1826-38 (June, 1957). In Italian.
A sound source, formed by a vibrating cylinder with a radial velocity varying in phase, is examined and it is shown with this source it is possible to concentrate sound in the direction of the axis of the cylinder. The directional characteristics and gain are obtained. An indication is given of how such a source can be realized practically by means of barium titanate cylinders. The radiation impedance of the cylinder is calculated, and it is shown that for an infinite cylinder the impedance is given by the ratio of two Hankel functions of the first order. A.

534.24

5737. ON THE REFLECTION OF ACOUSTIC WAVES ON A ROUGH SURFACE. M.A.Biot.
J. Acoust. Soc. Amer., Vol. 30, No. 5, 479-80 (May, 1958).
Corrections to a previous paper (Abstr. 3826/1958). H.D.Parbrook

534.26

5738. THEORY OF WAVE SCATTERING ON PERIODICALLY UNEVEN SURFACES. A REVIEW. Yu.P.Lysanov.
Akust. Zh., Vol. 4, No. 1, 3-12 (1958). In Russian.
A survey of the various methods of treating the problem, including those due to Rayleigh and Brekhovskikh, and the small-perturbation, integral equation, image and field coordination methods. 79 references (about one-third Russian). C.R.S.Manders

534.26

5739. ON THE SCATTERING OF A SOUND AT A NON-UNIFORM SURFACE. Yu.P.Lysanov.
Akust. Zh., Vol. 4, No. 1, 47-50 (1958). In Russian.
A method is given of solving the infinite system of algebraic equations derived in a previous paper (Abstr. 4938/1956). C.R.S.Manders

534.26

5740. SCATTERING OF SOUND BY A THIN ROD OF FINITE LENGTH. L.M.Lyamshev.
Akust. Zh., Vol. 4, No. 1, 51-8 (1958). In Russian.
A theoretical discussion is presented of the scattering of a plane, monochromatic sound-wave at a thin, finite, elastic rod of circular cross-section, taking into consideration the longitudinal and flexural vibrations of the rod. For certain angles of incidence strong scattering occurs in a direction opposed to that of the incident waves (i.e. so-called non-specular reflection). C.R.S.Manders

534.321.9 : 535.42

ON THE PHASE GRATING IN SUSPENSIONS CROSSED BY ULTRASOUNDS. See Abstr. 4904

534.321.9 : 535.42

DIFFRACTION OF LIGHT BY ULTRASONIC WAVES OF LARGE AMPLITUDE. See Abstr. 4903

534.321.9 : 541.15

SYNTHESIS OF AMMONIA AND CYANOGEN COMPOUNDS IN AN ULTRASONIC WAVE FIELD. See Abstr. 5507

534.7

PHYSIOLOGICAL ACOUSTICS. HEARING. See also under "Medical science. Human physiology". Decimal classification 612.85

OPTICS. RADIATION. SPECTRA

535.1

5741. DEGREE OF COHERENCE. P.H.van Cittert.
Physica, Vol. 24, No. 6, 505-7 (1958).
A new simple definition of the degree of coherence is proposed from which a previously proved theorem (Zernike, Abstr. 3674/1938) also used as a definition, can easily be derived. A.

535.23.08 : 536.33.08

A COMPARISON OF FAST INFRARED DETECTORS. See Abstr. 4917

535.244 : 576.72

5742. TWO NEW HISTOPHOTOMETERS FOR THE STUDY OF ABSORPTION CURVES. M.Vialli and L.Zanotti.
Ricerca sci., Vol. 27, No. 3, 814-24 (March, 1957). In Italian.
In one of the instruments described, the reference beam is independent of the optical system of the microscope; in the other, two diaphragms are placed side by side at the top of the microscope, one in the object beam and the other in the reference beam. By means of a quartz lens the light from these diaphragms is focused in turn on the same area of the cathode of a photomultiplier cell. The instruments can be used for making measurements in the u.v. J.W.T.Walsh

535.245.22

5743. METHOD FOR THE MEASUREMENT OF THE TOTAL FLUX OF A FLUORESCENT LAMP. M.Nonaka.
J. Opt. Soc. Amer., Vol. 48, No. 4, 246-9 (April, 1958).
In the measurement of the total flux of a fluorescent lamp with a physical photometer, the inconstancy of the photometer's spectral properties and the imperfection of its approximation to the average eye cannot be avoided. To overcome these defects, monochromatic comparison of radiant flux emitted by the fluorescent lamp and the standard lamp is made in a large integrating sphere. The entrance slit of the double monochromator is connected with a window of a 3.5-metre diameter integrating sphere, and the monochromatic light of the lamps is measured with a multiplier phototube whose linearity and stability are known. Besides, uncertainty of the spectral distribution of the standard tungsten lamp produces errors in measured values of luminous flux of fluorescent lamps, but the order of magnitude of these errors is within 0.3%. A.

535.3

5744. CONTRIBUTION TO THE MUTUAL RELATIONSHIPS OF CRYSTAL AND STRESS OPTICS. R.Plechata.
Acta tech. (Prague), Vol. 1, No. 5, 394-412 (1956). In German.
The theories of crystal and stress optics are presented in such a way as to emphasize the similarities and analogies which exist between the two theories. H.G.Jerrard

535.31 : 535.4

5745. COMPARISON BETWEEN WAVE OPTICS AND GEOMETRICAL OPTICS USING FOURIER ANALYSIS. II. ASTIGMATISM, COMA, SPHERICAL ABERRATION. K.Miyamoto.
J. Opt. Soc. Amer., Vol. 48, No. 8, 567-75 (Aug., 1958).
For Pt I see Abstr. 1583 (1958). The general theory developed in Pt I is applied to examples of astigmatism, coma and spherical aberration, and the following results are obtained. In the case of astigmatism, if the magnitude of the wave aberration $|\omega\lambda|$ is larger than 2λ (λ being the wavelength), the geometric optical response function $R_g(s)$ approximates to the wave optical response function $R_w(s)$ within the region of the normalized fre-

quency s, where $|\lambda s/2| < 0.2$. In the case of coma, if one considers the response function corresponding to the line image being perpendicular to the sagittal direction, $R_g(s)$ approximates to $R_w(s)$ when $|\omega\lambda| > 1.2\lambda$ and $|\lambda s/2| < 0.5$; furthermore, concerning the line image being perpendicular to the meridional direction, $R_g(t)$ approaches $R_w(t)$ when $|\omega\lambda| > 1.6\lambda$ and $|\lambda t/2| < 0.25$. Finally, in case of spherical aberration, $R_g(s)$ approximates to $R_w(s)$, if $|\omega\lambda| > 1.3\lambda$ and $|\lambda s/2| < 0.4$. A.

535.312 : 535.315

5746. STUDY OF LIGHT DEVIATION ERRORS IN TRIPLE MIRRORS AND TETRAHEDRAL PRISMS. P.R.Yoder,Jr.
J. Opt. Soc. Amer., Vol. 48, No. 7, 496-9 (July, 1958).

A procedure based upon vector analysis methods is outlined for the tracing of optical rays through triple-mirror and tetrahedral prism retrodirective reflectors. This procedure is utilized to determine the light deviation errors of such reflectors in terms of the errors in the three dihedral angles between the reflecting surfaces. It is shown that if the dihedral angles of a given reflector are in error by a tolerance amount $\pm\theta$, the resulting deviation errors of that reflector will not exceed $3.26\,\theta$ for a triple mirror or $3.26\,N\theta$ for a tetrahedral prism of refractive index N. Experimental verifications of the theoretical relationships developed are described. The procedures which are used in this verification are applicable to "in-process" and final inspection operations during the manufacture of prismatic retrodirective reflectors of moderate precision. A.

535.317.1

5747. ON THE APPLICATION OF THE BASIC THEOREM OF INFORMATION THEORY TO OPTICS. H.Wolter.
Physica, Vol. 24, No. 6, 457-75 (1958). In German.

The fundamental theorem of information theory, the Sampling Theorem (S.T.), does not give the smallest limits of measurement possible with a given system. These must be dictated by quantum theory in conjunction with the Uncertainty Principle. For an optical system the S.T. gives an integral over the field and aperture for the number n of independent solutions of the equation of wave motion obtainable. The application of quantum theory shows that in the representation of an image as a Fourier series n gives the number of coefficients which are large with respect to the remainder. However by suitable techniques the information carried by the remaining smaller coefficients could also be utilized.

W.T.Welford

535.317.1

5748. OPTICAL IMAGE EVALUATION FROM THE STANDPOINT OF COMMUNICATION THEORY. E.H.Linfoot.
Physica, Vol. 24, No. 6, 476-94 (1958).

The problem of optical image evaluation assumes a more tractable form when treated as a problem in communication theory. The complex amplitude distribution over the entry pupil of an optical system can be regarded as an intercepted part of a message sent out by the object, and the formation of an image in the focal plane of the system as a decoding of this intercepted message which presents information about the object in a more convenient form. An optical system can properly be said to be of high quality only if the amount of information contained in its images approaches the maximum possible with the prescribed aperture and receiving surface, and it is an agreeable consequence of the special properties of centred optical systems of the usual type that those which are efficient according to this criterion also form images which are sharp and clear in the usual sense of the words. Even so, fine detail may be metamorphosed, and it is worth considering whether a departure from maximum image-fidelity may not sometimes allow a useful gain in the amount of information recorded. An outline is also given of the analytical basis necessary for the discussion of information density in photographic images. The general approach is illustrated by computed curves giving the relative contributions from different spatial frequencies to the total information density in the aerial and photographic images of a low-contrast random object set in selected special cases. Analysis in this manner of the information density in photographic images provides a means whereby the traditional rough rules for matching objective and emulsion can be developed into a quantitative and theoretically satisfactory procedure, albeit one which needs the use of a fast electronic computer to handle the heavy computations involved. A.

535.317.1

5749. STIGMATIC LENSES. L.Lewin.
J. Opt. Soc. Amer., Vol. 48, No. 7, 500 (July, 1958).

A summation in closed form of a series occurring in the theory of concentric lenses of continuously varying refractive index. See Abstr. 8502 (1957). W.T.Welford

535.317.1

5750. APLANATIC SYSTEMS. C.Morais.
Atti Fond. Ronchi, Vol. 12, No. 1, 45-60 (Jan.-Feb., 1957). In Italian.

Starting from simple geometric properties of aplanatic points, a method of determining the lens surfaces necessary to obtain aplanatism is derived. The method is used to design a lens system which is aplanatic for an object at infinity. R.W.Fish

535.317.2

5751. EFFECT OF USING SIEMENS STAR AS SCANNING CHART IN MEASUREMENT OF RESPONSE FUNCTION. K.P.Miyake.
Sci. of Light (Tokyo), Vol. 7, No. 1, 9-13 (March, 1958).

The error in the value of the response function of optical systems obtained by using the Siemens star as a scanning chart is studied. For calculation of the response function, a circular area with uniform intensity of light is adopted as the image of point. Numerical calculation was performed by the FUJIC electronic computer. If correct values of the response function are required up to the spatial frequencies at which the response function has the first, second, and third zeroes, the Siemens stars with more than 16, 24, and 32 pairs of white and black lines may be used respectively. A.

535.317.

5752. A DOUBLET WITH A SINGLE REFRACTIVE INDEX FOR CHROMATIC CORRECTION. C.Morais.
Atti Fond. Ronchi, Vol. 11, No. 4, 320-33 (July-Aug., 1956).
In Italian.

A common technique of optical design is to correct the monochromatic aberrations and then substitute doublets instead of singlet the doublets being formed of glasses having the same mean index and different dispersions. The theory of such doublets is given and their use in reducing secondary chromatic aberration described. Sample calculations are given in detail. R.W.Fish

535.317.

5753. AN ASYMPTOTIC EXPRESSION FOR THE SPHERICAL ABERRATION FOR LARGE REFRACTIVE INDICES. M.T.Zoli.
Atti Fond. Ronchi, Vol. 12, No. 3, 255-8 (May-June, 1957).
In Italian.

The spherical aberration of a single refracting surface is found as the difference in the vergencies of the paraxial and marginal rays. It is expanded as a power series in 1/n. A series of graphs shows the errors that arise from using only the first terms in the expression. R.W.Fish

535.317.5

5754. OPTICAL ABERRATION COEFFICENTS. II. THE TERTIARY INTRINSIC COEFFICIENTS. H.A.Buchdahl.
J. Opt. Soc. Amer., Vol. 48, No. 8, 563-7 (Aug., 1958).

For Pt I see Abstr. 1989 (1957). The algebraic method for the determination of higher-order aberration coefficients based on the notion of quasi-invariance employs a process of iteration in which the nth step yields the exact coefficients of order $2n + 1$. To carry out the nth step one requires at each surface (i) all p and q coefficients of order less than $2n + 1$; (ii) the set of intrinsic p coefficients of order $2n + 1$ (the latter depending solely on the surface in question and not upon the coefficients which describe the imperfections implicit in that part of the system which precedes it). The present paper throws the monochromatic tertiary (i.e. seventh order) intrinsic coefficients of spherical surfaces into a very simple form eminently suitable for computation with an ordinary desk machine. The ten unbarred intrinsic coefficients, which alone appear in a suitably constructed computing scheme, require a total of only thirteen entries per surface. A.

535.323 : 538.614

5755. REFRACTIVE INDEX AND FARADAY EFFECT IN SOLID SOLUTIONS. D.L.Dexter.
Phys. Rev., Vol. 111, No. 1, 119-24 (July 1, 1958).

The change in the index of refraction and the magnitude of the Faraday effect are computed for non-metallic crystals (or solutions containing impurities or colour centres. Both effects are found to be easily measurable. A brief comparison with previous experimental and theoretical work is presented, and a suggestion is made for further experiments. A

535.324

5756. SIMPLE INTERFEROMETER FOR DISPERSION MEASUREMENTS OF LIQUIDS IN THE 2-22 μ REGION. R.E.Kagarise and J.W.Mayfield.
J. Opt. Soc. Amer., Vol. 48, No. 6, 430-1 (June, 1958).

Edser—Butler fringes are produced in the infrared 2-22 μ egion using as interferometer plates 40 ohm n-type germanium quare disks of side 25 mm polished to λ/4 flatness for yellow odium light. Reflectivity is adequate for good fringes. The 2-40 μ region is complicated because of absorption bands. The terferometer is crossed with an infrared prism spectrometer. he method is checked by deriving an infrared dispersion curve for CCl_4. Moderately accurate values are obtainable. S.Tolansky

535.33.03

757. LOW-PRESSURE DISCHARGES EMITTING LIGHT OF INIMUM NOISE. N.P.Carleton and O.Oldenberg.
Opt. Soc. Amer., Vol. 47, No. 11, 985-6 (Nov., 1957).

For the observation of weak absorption lines a background is esired that shows as small fluctuations as possible. The light from low pressure discharge serves this purpose under the following onditions: a d.c. discharge, viewed end on, using a plane cathode ounted in a glass tube of larger diameter; the pressure that pro-des the highest conductivity of the discharge or a somewhat higher ather than lower pressure; a power supply of high voltage combined ith a large series resistance. Under favourable conditions the light om the discharge produces a photoelectric current whose fluctu-ions are only about twice the inevitable shot noise. A.

535.33.03 : 539.18

758. ON THE PURITY OF MERCURY-198 PRODUCED BY EUTRON IRRADIATION OF GOLD-197. J.R.McNally, Jr.
. Opt. Soc. Amer., Vol. 47, No. 11, 1032-3 (Nov., 1957).

Calculations made under extremely pessimistic conditions for he allowable impurity of Hg^{199} in pile-produced Hg^{198}, to be used as possible primary standard of length, show that the 99.6% or better g^{198} produced in the Oak Ridge National Laboratory graphite reactor atisfactorily meets these rigid design criteria. A.

535.33.03

759. ELECTRODELESS DISCHARGE TUBES CONTAINING ARE EARTH AND HEAVY ELEMENT HALIDES.
.S.Tomkins and M.Fred.
. Opt. Soc. Amer., Vol. 47, No. 12, 1087-91 (Dec., 1957).

A method is described for the preparation of electrodeless ischarge tubes containing very pure rare earth and heavy element alides. Successful tubes have been prepared using Nd, Pm, Tb, , Pu, Np, and Am. The effect of changing vapour pressure of the etal in the discharge is discussed and representative spectra are hown. A.

535.33.03

760. ON THE MECHANISM OF FORMATION OF CONTINUOUS ACKGROUND IN THE EMISSION SPECTRUM OF HOT GASES.
.M.Biberman and V.E.Romanov.
ptika i Spektrosk., Vol. 3, No. 6, 646-8 (1957). In Russian.

A general expression is derived for the absorption coefficient llowing Chandrasekhar's treatment (1946). The results obtained re in good agreement with those found experimentally from high-ressure mercury lamps. L.Bovey

535.33.07

761. THE EFFECT OF ATMOSPHERIC PRESSURE ON A PECTROSCOPE. S.Guidarelli.
tti Fond. Ronchi, Vol. 12, No. 5, 423-30 (Sept.-Oct., 1957).
Italian.

Variations in the refractive index of the air, due to pressure hanges, will alter the focusing of optical systems. In a spectro-cope, a displacement of the spectral lines will result. The theory such changes is given for grating and prism spectroscopes. R.W.Fish

535.33.07 : 535.332

762. THE EXCITATION OF IONIC SPECTRA BY 100 kW HIGH REQUENCY PULSES. L.Minnhagen and L.Stigmark.
rk. Fys., Vol. 13, Paper 2, 27-36 (1957).

An apparatus for excitation of high-frequency pulses was eveloped and provided with a power amplifier containing a 25 kW ater-cooled triode. Pulse powers of up to approximately 100 kW re transferred to a discharge tube at a pulse duration of 80 μsec nd a repetition frequency of 40 pulses per sec. At the highest pulse owers spectra of singly (A II), doubly (A III), and trebly (A IV) ion-zed argon are excited, whereas only the A II and A III spectra ppear at lower peak powers, with a rapid increase of A III in rela-on to A II as the pulse power increases. Since the intensities of he A II, A III, and A IV lines are affected in different ways when the ulse power is changed, it is possible to settle conclusively the ion-zation stages to which the lines belong. A.

535.33.07

5763. RESOLUTION OF DOUBLET LINES IN SPECTRA BY A FOURIER SERIES TECHNIQUE. B.F.Canty and A.D.Franklin.
J. appl. Phys., Vol. 29, No. 5, 870-1 (May, 1958).

Shows how Stokes's method (Abstr. 4039/1948) can be applied when the doublet separation is unknown, provided the components are symmetrical in profile and have a known ratio of intensities. A.R.Stokes

535.33.07

5764. SIMPLE AND INEXPENSIVE f/1.1 PRISM SPECTRO-GRAPH. E.M.Reeves and R.W.Nicholls.
J. Opt. Soc. Amer., Vol. 48, No. 5, 358 (May, 1958).

The spectrograph, for use in the study of very feeble light sources, is of conventional design and employs a large flint-glass prism and a commercially available 35 mm camera with an f/1.1 lens. Reciprocal dispersions of 130 A/mm at 4050 A, 360 A/mm at 5050 A, and 1400 A/mm at 7000 A enable identifications to be made with acceptable accuracy (±2 A at 4300 A) from microdensitometer traces. R.W.Nicholls

535.33.07

5765. A SPECTROGRAPH ATTACHMENT FOR HIGH SPEED CAMERAS. D.P.C.Thackeray.
J. sci. Instrum., Vol. 35, No. 7, 248-52 (July, 1958).

The attachment will convert any camera into a spectrograph. Used with two typical high-speed cameras, time resolved spectrography of small sources is possible with a wavelength resolution of 3 A at 5780 A and resolution times down to less than 10^{-7} sec. With a third camera, spectra of phenomena having a spatial dimension may be recorded at rates up to 1.6×10^6 frames/sec. A.

535.33.07 : 535.24

5766. A MICROPHOTOMETER WITH AUTOMATIC RECORDING OF INTENSITY. A.Kranjc.
Mem. Soc. Astron. Ital., Vol. 28, No. 4, 361-74 (1957). In Italian.

Generally a microphotometer records transparency of the plate; with the aid of the characteristic curve it is possible to transform the values of transparency into values of intensity. The numerical calculation can be avoided if the amplifier of the photoelectric current delivered by the microphotometer has a response curve similar to the calibration curve and if this curve is easily changed. A microphotometer using this principle is described. A.

535.33.07 : 535.332

5767. EXCITATION FUNCTIONS OF THE TRIPLET LINES 4713 AND 5876 A OF HELIUM MEASURED WITH LOW ENERGY ELECTRONS. C.Smit, W.J.Vredenberg and J.A.Smit.
Physica, Vol. 24, No. 5, 380-2 (May, 1958).

Describes an optical system incorporating a photomultiplier for the determination of excitation functions. At 4000 A, 400 photon/sec could be measured. The "fine structure" of the 4713 A and 5876 A line excitation function is shown graphically and is briefly discussed. J.D.Craggs

535.33.07

5768. AUTOMATIC SPECTROMETER USING INTERFERENCE FILTERS. E.Rohner and M.J.O.Strutt.
Rev. sci. Instrum., Vol. 28, No. 12, 1074-8 (Dec., 1957).

The spectrometer yields spectra of light sources, reflecting surfaces and filters well within one second. It may be adjusted for obtaining integral spectral values and colour coordinates of the above objects within one second. A.

535.33.07 : 539.1.07

5769. IODINE-VAPOR-FILLED ULTRAVIOLET PHOTON COUNTER. R.T.Brackmann, W.L.Fite and K.E.Hagen.
Rev. sci. Instrum., Vol. 29, No. 2, 125-8 (Feb., 1958).

A device for the sensitive detection of radiation in the range from 1080 to 1260 A is described. It is a Geiger-Müller counter in which the counts are initiated by the photoionization of iodine vapour used in the tube's filling. The range of response is determined by the ionization potential of iodine and the short wavelength cut-off of LiF, through which radiation enters the counter. Because of iodine vapour in the filling, the electrical characteristics of the tube are those of a halogen-quenched counter. A.

535.33.07 : 537.56

A PULSE DISCHARGE IN A RESTRICTED CHANNEL AS A SPECTROSCOPIC SOURCE. See Abstr. 5066

535.33.07 : 522.6

THE OPTICAL DESIGN OF A SOLAR SPECTROGRAPH. See Abstr. 5577

535.331/.332 : 539.18

ORBIT–ORBIT INTERACTIONS IN ATOMIC SPECTRA. See Abstr. 5415

535.331

5770. COMPARATIVE INVESTIGATIONS OF THE METROLOGICAL PROPERTIES OF Pb^{206} AND Cd^{114} SPECTRAL LINES. N.R. Batarchukova.
Optika i Spektrosk., Vol. 4, No. 1, 112-13 (1958). In Russian.

The lead sample (80% Pb^{206}) was excited by an electrodeless discharge method at 180-200 Mc/s. The line 5005.4301 A was inferior in both width and wavelength stability to the red Cd line. However, it is suggested that the use of the pure Pb^{206} might give a more favourable comparison. L.Bovey

535.331 : 537.525.5

ATOMIC EMISSION SPECTRA OF ARC DISCHARGES. See Abstr. 5032-3

535.331 : 537.527.5

5771. THE EMISSION FROM HIGH PRESSURE MERCURY ARCS IN THE "TOTAL" INFRARED. J.Bohdansky.
Z. Phys., Vol. 149, No. 3, 383-96 (1957). In German.

Experiments on the measurement of radiation in the wavelength ranges from 1 to 16 μ and from 60 to 320 μ are described. Arc pressures varied from 300 to 750 mm Hg. Absolute radiation intensities, and their pressure variations are quoted, and are discussed in terms of arc temperatures etc. J.D.Craggs

535.332

5772. HYPERFINE STRUCTURES OF THE RESONANCE LINES OF INDIUM 115. D.A.Jackson.
Proc. Roy. Soc. A, Vol. 246, No. 1246, 344 (1958).

Spectroscopic measurements reported in an earlier paper (Abstr. 787/1958) are converted to vacuum wave-numbers to give a true comparison with microwave measurements. A.

535.333 : 534.222.2

5773. C_2 AND CN EMISSION IN THE SHOCK TUBE.
G.Charatis, L.R.Doherty and T.D.Wilkerson.
J. chem. Phys., Vol. 27, No. 6, 1415-16 (Dec., 1957).

Time-resolved spectrograms of primary and reflected shocks through rare gases containing traces of CH_4, C_2H_2 and mixtures of CH_4 and NH_3 show that C_2 and CN bands are strongest in the front, to within 1 μsec, irrespective of whether C–C bonds are initially present. It is suggested that CH_4 and NH_3 are dissociated to C and N atoms in electronic states of a type which can combine to form C_2 and CN in excited states. A.G.Gaydon

535.333 : 539.19 : 537.525

HYDROXYL AND MOLECULAR NITROGEN BANDS IN H.F. DISCHARGES. See Abstr. 5026

535.338.333 : 539.18

ISOTOPIC SPECTRAL ANALYSIS OF LEAD. See Abstr. 5436

535.333 : 539.19

EXCITATION AND DISSOCIATION OF HYDROGEN BY AN ELECTRON SWARM. VACUUM U.V. RADIATION INTENSITY. See Abstr. 5456

535.337 : 538.615

5774. MICROWAVE ZEEMAN EFFECT AND THEORY OF COMPLEX SPECTRA. F.R.Innes and C.W.Ufford.
Phys. Rev., Vol. 111, No. 1, 194-202 (July 1, 1958).

A treatment in spherical tensors of the microwave Zeeman interaction of Abragam, Kambe, and Van Vleck is given. A calculation of g-factors in atomic oxygen is then made and the numerical values compared with those worked out previously. New methods and results are developed for finding matrix elements of one-particle and two-particle operators for wave-functions which contain more than one group of equivalent particles. The generality of these results is such that they may be used in the various coupling schemes of atomic and nuclear shell models. A.

535.34.07

5775. SMALL INFRARED SPECTROMETER.
J.U.White, N.L.Alpert and S.Weiner.
Rev. sci. Instrum., Vol. 29, No. 6, 511-16 (June, 1958).

The instrument, built for general use in the chemical laboratory, employs a rock salt prism with a 40 × 50 mm base. It records the spectra of samples linearly in transmittance or absorbance v. wavelength on flat 8 × 23½ in. charts. Its single set of scanning conditions covers the range from 2 to 16 μ in 16 min with a resolution of 3 to 4 cm^{-1} at 10 μ, and scattered light of less than 1% at 15 μ. A.

535.34.0

5776. PHOTOELECTRIC SPECTROPHOTOMETERS. I.Soudek.
Slaboproudý Obzor, Vol. 19, No. 5, 300-2 (1958). In Czech.

General description and a brief comparison of two spectrophotometers are given. One of the instruments employs a Soviet, type UM2, monochromator and consists of a photomultiplier and a differential valve-voltmeter, the range of which is from 0.03 to 300 μA. The second photometer employs a two-octave photocell an a potentiometer circuit with an electrometer amplifier, which is used as the null indicator. The instrument is about three times les sensitive than the first photometer. Both the instruments are supplied from stabilized power sources and are furnished with special, high-insulation range-switches. R.S.Sidorowic

535.343 : 535.37

5777. ABSORPTION AND FLUORESCENCE SPECTRA OF IONS IN CRYSTALS. W.A.Runciman.
Rep. Progr. Phys., Vol. 21, 30-58 (1958).

The absorption and fluorescence spectra provide direct information about the energy levels of the ions in a crystal. Alternatively, the ions may be regarded as probes measuring the crysta line field. The introduction deals with the influence of the crystal c the energy levels of the free ions. After a brief description of the experimental techniques, which include measurements down to 1°K, the various ion groups are considered in some detail. Ions of the 3 group are often in approximately octahedral surroundings, and the spectra of such complex ions are described. Then the 4d and 5d groups are discussed, The theory of the spectra of rare-earth salt is reviewed with special reference to polarization and Zeeman effe and the individual ions are considered. Lastly there are two sectio devoted to the heavy metal ions, including thallium, and to uranium and the transuranics, which are of interest because of the importan of the 5f electrons in the interpretation of the spectra. A

535.34

5778. ^6P STATE OF THE Gd^{+++} ION. S.P.Cook and G.H.Dieke.
J. chem. Phys., Vol. 27, No. 5, 1213 (Nov., 1957).

The $^8S_{7/2} \leftarrow {}^6P_{5/2}$ component of the $^8S_{7/2} \leftarrow {}^6P$ transition of Gd^{++} has now been observed (together with the $^8S_{7/2} \leftarrow {}^6P_{3/2,7/2}$ components) in the absorption spectra of $GdAc_3.4H_2O$ and $Gd_2(SO_4)_3.8H_2O$ crystals at 77° K and 4.2° K. R.W.Nicholls

535.343 : 535.337

5779. ABSORPTION, FLUORESCENCE, AND MAGNETIC PROPERTIES OF GADOLINIUM CHLORIDE ($GdCl_3.6H_2O$).
G.H.Dieke and L.Leopold.
J. Opt. Soc. Amer., Vol. 47, No. 10, 944-54 (Oct., 1957).

A study of the Zeeman effect of absorption lines of $GdCl_3.6H_2O$ and its dependence on the orientation of the crystal has given the constants for the magnetic ellipsoids for the ground state and 11 excited states. Evidence is presented for identifying the first three absorption groups as transitions from ^8S to $^6P_{7/2}$, $^6P_{5/2}$, and $^6I_{7/2}$. The magnetic observations were made at 77°K, 4.2°K, and 1.7°K and field-free spectra also taken at 195°K and 273°K. Very strong fluorescence is observed from the lowest excited state to the ground state. The magnetic axes are approximately but not exactly the same for all observed states. The direction of maximum susceptibility is not that of the twofold crystal axis but perpendicular to it. There are small but definite deviations from isotropic magnetic behaviour for the ground state. A.

535.343 : 537.311.33

INTENSITY OF OPTICAL ABSORPTION BY EXCITONS. See Abstr. 4952-3

535.343

5780. INFRARED ABSORPTION SPECTRA OF SO_2 AND CO_2 IN AQUEOUS SOLUTION. L.H.Jones and E.McLaren.
J. chem. Phys., Vol. 28, No. 5, 995 (May, 1958).

The similarity of the vibrational spectra of gas and solution, indicates the presence in the solutions of SO_2 and CO_2, rather than H_2SO_3 and H_2CO_3. G.F.Lothian

535.343

5781. THE INFRA-RED AND RAMAN SPECTRA OF ICE.
N.Ockman.
Advances in Phys., Vol. 7, 199-220 (April, 1958).

A review of all the published work up to September 30, 1957. The results of the infrared investigations of hexagonal and cubic ice (H_2O, D_2O and HDO in both cases) are set out in detail, together with the results of the Raman studies of hexagonal ice (H_2O and D_2O). A review of the interpretation of the spectra in terms of structure models is given, and the various assignments of frequencies which have been suggested for both hexagonal and cubic ice are discussed. (See also Abstr. 6519-20/1958). S.Weintroub

535.343 : 539.2

5782. INFRARED ABSORPTION BANDS IN α-QUARTZ.
D.L.Wood.
J. chem. Phys., Vol. 27, No. 6, 1438-9 (Dec., 1957).

A group of at least nine bands near 3400 cm^{-1} are found not to obey Lambert's law and are hence attributed to lattice imperfections. Experiments on effects on the bands after neutron and X-irradiation, and after heat treatment suggest that they may be due to electronic changes around an interstitial or substitutional impurity.

G.F.Lothian

535.343

5783. INFRARED SPECTRUM OF CYANATE ION AS A SOLID SOLUTION IN A POTASSIUM IODIDE LATTICE.
A.Maki and J.C.Decius.
J. chem. Phys., Vol. 28, No. 5, 1003-4 (May, 1958).

By this separation of the CNO ions from one another, perturbations due to lattice interactions are reduced and resolution is greatly improved. Measurements are made down to 140°K on various isotopic combinations. Lines over the range 4900-628 cm^{-1} are listed and assignments given.

G.F.Lothian

535.343

5784. INFRARED SPECTRUM OF ANTIMONY TRICHLORIDE–BENZENE COMPLEX. L.W.Daasch.
J. chem. Phys., Vol. 28, No. 5, 1005-6 (May, 1958).

The spectrum of a saturated solution of $SbCl_3$ in benzene is compared with that of pure benzene from 670 to 5000 cm^{-1}. The observed intensity effects suggest the C_{3v} (staggered) to be the most likely symmetry of the complex.

G.I.W.Llewelyn

535.343

5785. PRECISION MEASUREMENTS OF MILLIMETER AND SUBMILLIMETER WAVE SPECTRA: DCl, DBr, AND DI.
M.Cowan and W.Gordy.
Phys. Rev., Vol. 111, No. 1, 209-11 (July 1, 1958).

Precision frequency measurements were made on the J = 0 → 1 transitions of the deuterium halides DCl, DBr and DI. The molecular constants derived from these measurements are

	DCl^{35}	DCl^{37}
ν_0 in Mc/s	323 295.77 ± 0.13	322 349.69 ± 0.13
Quadrupole coupling eQq(hal.) in Mc/s	67.3 ± 0.7	53.0 ± 0.7
Magnetic coupling C(hal.) in Mc/s	0.03 ± 0.10	0.00 ± 0.10
B_0 in Mc/s	161 656.10 ± 0.07	161 183.01 ± 0.07
B_e in Mc/s	$163\,34_0$	$162\,85_0$
r_0 in A	1.2812_8	1.2812_4
r_e in A	1.2746_2	1.2746_2

	DBr^{79}	DBr^{81}
ν_0 in Mc/s	254 704.675 ± 0.050	254 548.914 ± 0.050
Quadrupole coupling eQq(hal.) in Mc/s	530.5 ± 0.3	443.5 ± 0.3
Magnetic coupling C(hal.) in Mc/s	0.15 ± 0.04	0.16 ± 0.04
B_0 in Mc/s	$127\,357._8$	$127\,279._7$
B_e in Mc/s	$128\,6_{15}$	$128\,5_{98}$
r_0 in A	1.4214_4	1.4214_4
r_e in A	1.414_5	1.414_5

	DI^{127}
ν_0 in Mc/s	195 067.866 ± 0.040
Quadrupole coupling eQq(hal.) in Mc/s	1823.3 ± 0.3
Magnetic coupling C(hal.) in Mc/s	0.17 ± 0.02
B_0 in Mc/s	$97\,537._1$
B_e in Mc/s	$98\,44_7$
r_0 in A	1.6166_0
r_e in A	1.609_1

The constants D_0 and α from infrared data were employed in the calculation of the B and r values.

A.

535.347

5786. INFRARED DICHROISM OF MUTUALLY PERPENDICULAR NORMAL MODES IN ORIENTED HIGH POLYMERS.
C.Y.Liang and S.Krimm.
J. chem. Phys., Vol. 27, No. 6, 1437-8 (Dec., 1957).

The infrared dichroism is examined with particular reference to its structural implications. The relationships between the transition moments and the angles between them and their orientations are tabulated for perfect orientation. These relationships are not seriously affected by small deviations from perfect orientation. The results are discussed in cases where two of the modes associated with a unit exhibit parallel polarization as seems to be the case for cellulose and polyethylene terephthalate.

H.G.Jerrard

535.361.2

5787. NOTE ON PERFECT LAMBERTIAN DIFFUSERS.
M.Sussman.
J. Opt. Soc. Amer., Vol. 48, No. 4, 275-6 (April, 1958).

Simplified derivation of a formula for the light reflected from a sphere with a perfectly diffusing (Lambertian) surface.

W.T.Welford

535.37

5788. POLARIZATION OF PHOTOLUMINESCENCE OF ORGANOPHOSPHORS. A.Bączyński and M.Czajkowski.
Bull. Acad. Polon. Sci. Sér. sci. math. astron. phys., Vol. 6, No. 4, 271-4 (1958).

Measurements were made of the emission anisotropy of a mixture of fluorescence and phosphorescence of fluorescein in boric acid, as a function of excitation wavelength (4000-5200 A). The reduction of emission anisotropy within the region of maximum relative phosphorescence yield is accounted for by the admixture of weaker polarized phosphorescence to the fluorescence.

J.B.Birks

535.37 : 548.7

5789. LUMINESCENCE FROM X-RAY COLORED KBr CRYSTALS DURING PLASTIC DEFORMATION. H.R.Leider.
Phys. Rev., Vol. 110, No. 4, 990-1 (May 15, 1958).

The emission spectrum of luminescence consists of a broad band with a maximum at 4000 A. It is suggested that stress application causes dislocation motion, which releases trapped electrons, the latter recombining with positive holes to give the emission observed. See also Abstr. 5213/1957.

G.F.J.Garlick

535.371 : 535.373

5790. THE RELATIONSHIP BETWEEN THE QUANTUM YIELDS OF PHOSPHORESCENCE AND FLUORESCENCE AND THE FLUORESCENCE SPECTRUM POSITION.
V.V.Zelinskiĭ and V.P.Kolobkov.
Dokl. Akad. Nauk SSSR, Vol. 119, No. 5, 922-5 (1958). In Russian.

535.371

5791. QUANTUM EFFICIENCY OF F-CENTRE FLUORESCENCE IN KCl. C.Z.van Doorn.
Philips Res. Rep., Vol. 13, No. 3, 296-300 (June, 1958).

The quantum efficiency of F-centre fluorescence at 77°K in X-ray and additively coloured KCl was measured using an integrating sphere. Values of up to 91% have been found, depending on the concentration of F and M centres.

A.

535.371

5792. RADIATIONLESS RECOMBINATION IN PHOSPHORS.
L.Bess.
Phys. Rev., Vol. 111, No. 1, 129-32 (July 1, 1958).

An Auger-type process is proposed for a possible means of nonradiative annihilation of free holes at electron traps in phosphors. A rough calculation is made of the cross-section for the process, and some of the consequences are considered qualitatively.

A.

535.371.07

5793. MEASUREMENT OF EXTREMELY SHORT AFTERGLOW TIMES IN ELECTRON-EXCITED PHOSPHORS. K.Heine.
Elektron. Rdsch., Vol. 12, No. 5, 164-7 (May, 1958). In German.

A description is given of an arrangement of conventional type for measuring the rise and decay times of screens under cathode-ray excitation, with a lower limit of about 10^{-8} sec. Phosphor characteristics are discussed, and the special details of each part of the circuit, namely the pulse generator for modulating the cathode-ray tube, the circuits associated with the latter, the photomultiplier, the amplifiers and the time base. With photography of the oscilloscope an accuracy of measurement of 10% is possible in the range of 1 to 0.1 μsec.

S.T.Henderson

535.372

5794. THE NATURE OF THE EDGE EMISSION IN CdS.
G.Diemer, G.J.van Gurp and M.J.G.Meyer.
Physica, Vol. 23, 987-8 (Oct., 1957).

The edge emission of pure CdS crystals in the region from 5000 to 5500 A was measured at 77°K. A sub-linear relationship

was found between emission and excitation intensity, indicating that the green emission bands were not due to the decay of excitons.

J.Franks

535.376

5795. SOME EFFECTS OF ELECTRIC FIELDS ON THE LUMINESCENCE OF ZnS SINGLE CRYSTALS. J.Woods.
J. Electronics and Control, Vol. 3, No. 5, 531-3 (Nov., 1957).

Blue emitting, green emitting and non-photoluminescent crystals showing no a.c. electroluminescence were found to exist under the action of d.c. fields ($\sim 5 \times 10^4$ V/cm). The emission occupies all the cathode–anode space. Afterglow and thermoluminescence of blue and green luminescent crystals are enhanced by a.c. or d.c. fields, which also enhance the photoluminescence. In crystals with high Cu and Cl contents d.c. excited emission was in the region of the cathode. Tentative explanations are given. G.F.J.Garlick

535.376

5796. ELECTROLUMINESCENCE FROM THE SURFACE LAYER OF $BaTiO_3$, $SrTiO_3$, AND ASSOCIATED MATERIALS. G.G.Harman.
Phys. Rev., Vol. 111, No. 1, 27-33 (July 1, 1958).

Electroluminescence resulting from high-frequency excitation ($> \sim 500$ kc/s), was observed in $BaTiO_3$, $SrTiO_3$, and associated materials. It is shown that the light emission is the result of a high r.f. field across a thin surface barrier. The efficiency of this emission is very low, and a tentative value of 10^{-6} % was obtained. A model involving field emission from the metal electrode into the crystal surface-layer is proposed to explain the observed phenomena. The characteristics of this surface-layer are relatively insensitive to temperature, from at least -40° C to 300° C. The ratio of permittivity to thickness, ϵ/L, was found to have a value of $\leq 1.4 \times 10^8$ cm^{-1} for the $BaTiO_3$ surface-layer. A.

535.376

5797. THE SIGNIFICANCE OF EDGE-LAYERS AND POLARIZATION FIELDS IN ELECTROLUMINESCENCE. D.Hahn and F.W.Seemann.
Z. Phys., Vol. 149, No. 4, 486-503 (1957). In German.

Square waveform voltage pulses were applied to electroluminescent cells containing phosphors without binders. The pulses could be all positive, all negative, or alternating (with or without constant bias added). Photographs are shown of different types of light wave with the main pulses in phase. Subsidiary maxima appear when the a.c. pulses are biased. Temperature effects and phase relations are discussed. Afterglow after very brief excitation is exponential for ZnS:Mn, hyperbolic for other phosphors such as ZnS:Cu,Al. Under d.c. a flash is followed by very lengthy decay of light and current due to polarization. The experimental results are discussed in detail from the standpoint that, at the low voltages used, the factor controlling light output is the barrier-layer at the electrodes (particularly the conducting glass surface), while subsidiary maxima of light emission are caused by polarization. S.T.Henderson

535.376

5798. CATHODO-ELECTROLUMINESCENCE PHENOMENA IN ZINC SULPHIDE PHOSPHORS. H.Gobrecht, H.E.Gumlich, H.Nelkowski and D.Langer.
Z. Phys., Vol. 149, No. 4, 504-10 (1957). In German.

The effects are described of applying an a.c. field to electroluminescent cells made with araldite, which are also exposed to the electron beam in a cathode-ray tube. For a normal electroluminescent ZnS:Cu,Al the field exerts a quenching effect, hence the light output is less than the sum of electroluminescence and cathodoluminescence excited separately. The degree of quenching increases with cell voltage and frequency, decreases with greater loading in the electron beam, but does not alter the voltage threshold of electroluminescence. A sample of ZnS:Mn which is not electroluminescent, but shows Destriau's enhancement effect on the red band (e.g. by X-rays and a simultaneous field), behaves similarly under cathode rays: the blue emission band is quenched and the red enhanced roughly in proportion to the a.c. field applied to the cell.

S.T.Henderson

535.377

5799. ELECTRON TRAPS PRODUCED IN KCl BY QUENCHING OR PRESSURE. J.Ewles, S.C.Jain and R.V.Joshi.
Proc. Phys. Soc., Vol. 71, Pt 5, 852-6 (May, 1958).

Glow peaks (thermoluminescence) were observed in KCl quenched under various conditions (most prominent peak around 250°K), and in KCl subjected to high pressures (most prominent peak around 200°K). A.B.Lidiard

535.377

5800. THE THERMOLUMINESCENCE OF NATURAL FLUORSPAR. K.Luchner.
Z. Phys., Vol. 149, No. 4, 435-52 (1957). In German.

The thermoluminescence curves of natural fluorite were measured both for virgin crystals and after subsequent X-ray dosage. The dependence on dosage was studied for separate glow peaks, and a quantum counter used to obtain absolute light emission values. A glow-curve theory is developed in a way that enables mono- or bi-molecular kinetics to be distinguished in analysis of the curves for fluorite. G.F.J.Garlick

535.39 : 539.23

5801. MEASUREMENT OF THE OPTICAL CONSTANTS OF THIN DIELECTRIC FILMS BY MEANS OF FRUSTRATED TOTAL REFLECTION. B.P.Sanford.
J. Opt. Soc. Amer., Vol. 48, No. 7, 482-6 (July, 1958).

It is shown that the transmission of light through a thin dielectri film under conditions of frustrated total reflection can be used to measure the refractive index and thickness of the film. The refractive index and thickness were measured for each of several magnesium fluoride films. The thickness was checked in each case by multiple beam interference and the refractive index compared with the results obtained by other authors for similar films. It appears that many present concepts on which the theory of the optical properties of thermally evaporated films is based are inadequate for the problems involved. A.

535.39 : 535.345.6

5802. NEW METHODS OF CHROMATIC AND ACHROMATIC BEAM SPLITTING. H.Pohlack.
Wiss. Z. Hochsch. Elektrotech. Ilmenau, Vol. 3, No. 3-4, 277-87 (1957). In German.

This article reviews thin film mirrors and filters, and gives an account of the main properties of metallic and dielectric films. Vacuum deposition of the films is described and their main uses illustrated. R.W.Fish

535.39 : 537.311.33

MODULATION OF LIGHT REFLECTED BY SEMICONDUCTORS
See Abstr. 4975-6

535.391 : 539.234

5803. ACHROMATIC ANTI-REFLECTION COATING FOR PRACTICAL USE. T.Sawaki.
Sci. of Light (Tokyo), Vol. 7, No. 1, 1-8 (March, 1958).

Non-absorbing film was made by vacuum-evaporating Sb_2O_3 using an alumina heater. An achromatic anti-reflection coating was produced by combining this film with a MgF_2 film. The coating is sufficiently durable for practical use. A.

535.392

5804. COLORS PRODUCED BY REFLECTION AT GRAZING INCIDENCE FROM ROUGH SURFACES. W.E.K.Middleton and G.Wyszecki.
J. Opt. Soc. Amer., Vol. 47, No. 11, 1020-3 (Nov., 1957).

Using a precision spectrometer with a photomultiplier attached to its telescope, the specular reflection of light from various rough surfaces was measured at angles of incidence in the region from 80° to 89°. Seven interference filters were used to isolate spectral bands covering the visible spectrum. From the measured values of reflectance the chromaticity of the specularly reflected light was computed, assuming C.I.E. source "A" for the incident light. It was found that at all angles the resulting colours lay in a narrow region near the Planckian locus, being more reddish than the incident light. The maximum redness was found at an angle where the specular reflectance had already become small. It is shown to be likely that if the specularly reflected light could be isolated the surface would form an accurate means of reducing colour temperature. A.

535.399

5805. CALCULATION OF THE OPTICAL CONSTANTS OF IONIC CRYSTALS IN THE INFRARED FROM THE REFLECTION SPECTRUM. F.Abeles and J.Mathieu.
Ann. Phys. (Paris), Ser. 13, Vol. 3, No. 1-2, 5-32 (Jan.-Feb., 1958). In French.

A method is developed of obtaining the optical constants n and k of ionic crystals in the infrared, given the reflection coefficient at normal incidence. It is particularly useful when the absorption is so large that very thin samples are required for transmission measurements. The method is applied to NaCl, KCl, TlCl, ZnS, $Pb(NO_3)_2$, $CaCO_3$, TiO_2. The maximum of the(n,k)– λ curves gives the wavelength λ_0 of transverse waves corresponding to the fundamental fre-

quency ν_0 of vibration of the lattice. The intersection of the n–λ and k–λ curves gives the wavelength λ_1 of longitudinal waves with frequency ν_0. With the exception of λ_0 for TlCl, calculated and observed values of λ_0 and λ_1 are in good agreement. B.T.M.Willis

535.412 : 535.333

5806. ANALYSIS OF INTERFERENCE FRINGES FROM A FLAME. B.W.Harned and N.Ginsburg.
J. Opt. Soc. Amer., Vol. 48, No. 3, 178-83 (March, 1958).

The CH emission from an oxyacetylene flame at atmospheric pressure was examined with a Fabry–Perot interferometer crossed with a grating spectrograph. The fringe patterns are analysed, using four different methods of reduction of data. Poor agreement is observed with theoretical intensity line contours for combined instrumental and Doppler broadening. The graphical integration technique of Gaydon and Wolfhard is employed to estimate the amount of collision broadening. Translational equilibrium conditions are observed to exist for CH in the flame, with temperature near the maximum theoretical adiabatic value. A.

535.417 : 531.715.1

5807. OBLIQUITY EFFECTS IN INTERFEROMETRY. C.F.Bruce and B.S.Thornton.
Austral. J. Phys., Vol. 10, No. 2, 324-5 (June, 1957).

A correction to a numerical factor in a formula given previously (Abstr. 8655-6/1955). W.T.Welford

535.417

5808. PHOTOELECTRIC FRINGE SIGNAL INFORMATION AND RANGE IN INTERFEROMETERS WITH MOVING MIRRORS. G.W.Stroke.
J. Opt. Soc. Amer., Vol. 47, No. 12, 1097-103 (Dec., 1957).

Photoelectric receptors and electronics have greatly increased the accuracy and simplicity of interferometric measurements. Theoretical and experimental investigations of instrumental and light source conditions required to ensure adequate information content and "visibility" of fringe signals were made. Mirror parallelism requirements needed to maintain maximum signal modulation and to reduce apparent local displacement errors, for use with equal inclination interferometers, are expressed by the fractional number of equal thickness fringes within the mirror aperture, the sensitivity to varying rotation along the mirror traverse being reducible by decreasing this aperture and ensuring best local parallelism. The "effective" length per fringe, determined by photoelectric flux integration over an angular range within the source angular radius α_s is approximately $(\lambda/n)/2(1 - \alpha_s^2/4)$. Theoretical expressions obtained for the fringe "visibility" with simple single isotope lines of Gaussian shape are in good accord with experiments, showing that the fringe amplitude with perfectly adjusted continuously moving interferometers is governed by an expression of the form

$$\exp[-4\pi^2 l^2 \sigma^2 n^2][\sin(\pi l \alpha_s^2 n/\lambda)/(\pi l \alpha_s^2 n/\lambda)] \times \times [\cos\{[2\pi l(1 - \alpha_s^2/4)]/[(\lambda/n)/2]\}],$$

usable for estimating interferometric range with such sources as the green Hg^{198} line with an effective Gaussian width of about two Doppler widths at room temperatures. The further extension of interferometric range with measurement precisions of 1 part in 10^8 over traverses exceeding 300 mm appears feasible. A.

535.417 : 531.715 : 539.232

5809. NONDESTRUCTIVE INTERFEROMETRIC THICKNESS MEASUREMENT OF THIN TRANSPARENT FILMS. R.L.Sauer.
J. Opt. Soc. Amer., Vol. 48, No. 4, 275 (April, 1958).

The thickness of anodic oxide coating of Al is measured interferometrically in the range 0.00005 to 0.001 inch. S.Tolansky

535.417 : 534.133

5810. MULTIPLE-BEAM INTERFEROMETRIC STUDIES ON OSCILLATING QUARTZ CRYSTALS. S.Tolansky and A.F.B.Wood.
Physica, Vol. 24, No. 6, 508-18 (1958).

Multiple-beam interferometry is used to study the displacements perpendicular to the surface associated with the longitudinal vibrations of a circular Z-cut quartz disk. The interference patterns reveal the existence of a flexural displacement coupled to the displacements predictable by an approximate theory. Studies are also made using multiple-beam interference fringes formed by light beams reflected between the two surfaces of the disk. The interference pattern is then determined by the stresses within the disk but is unaffected by the particular distribution of stresses associated with the flexural displacement. The resulting nodes agree well with those predicted theoretically. The interferometric technique employed, not only reveals the complete distribution of nodes and antinodes, but also permits of an exact evaluation of local amplitudes. A.

535.417

5811. THE SETTING ACCURACY IN TWO-BEAM INTERFEROMETRY. M.Bottema.
Physica, Vol. 24, No. 6, 519-28 (1958).

The accuracy of some setting methods applicable in two-beam interferometry is investigated with regard to its dependence on the conditions of observation. Photometric methods prove to be the most advantageous. With these, an accuracy of a few thousandths of a wavelength in one setting is attainable under favourable conditions. A.

535.417 : 531.717.1

5812. THE MEASUREMENT OF THIN FILMS BY INTERFEROMETRY. J.Dyson.
Physica, Vol. 24, No. 6, 532-7 (1958).

In view of the high accuracy of comparison of path-differences attainable in polarimetry, experiments were made to achieve some of this accuracy in thin film measurements. It is shown experimentally that setting accuracies are obtainable corresponding to an error of thickness measurement of ±1 A. A.

535.417

5813. REVERSIBLE PHOTOELECTRIC FRINGE COUNTING. R.L.Eisner.
Rev. sci. Instrum., Vol. 29, No. 6, 521-3 (June, 1958).

Simple modifications of a Fizeau interferometer are shown which give a sense of direction to the passing fringes, enabling a suitable counting system to operate reversibly. Very fast counts can be made accurately using an electronic circuit actuated by four phototubes sighted on four points in the fringe pattern. An oscilloscope display can be used for fractional fringe interpolation. A.

535.417 : 531.715

5814. AN INTERFERENCE COMPARATOR FOR EVALUATING THE DIFFERENCE BETWEEN END-STANDARDS. M.Dühmke.
Z. InstrumKde, Vol. 65, No. 1, 5-17 (Jan., 1957). In German.

By employing a difference method against a standard, lengths of slip-gauges (up to 100 mm) can be evaluated to within 0.01 μ. The method described enhances the Fizeau-fringe sharpness by multiple reflection. S.Tolansky

535.42

5815. THE METHOD OF STATIONARY PHASE AND THE METHOD OF FRESNEL ZONES. N.G.van Kampen.
Physica, Vol. 24, No. 6, 437-44 (1958).

The method of stationary phase is discussed and reasons are given why it is often preferable to the method of steepest descent, in spite of the mathematicians' partiality to the latter. The method of Fresnel zones is compared with the method of stationary phase and is shown to be a primitive version of it. The purpose of the zones is to reduce the double integral to a single integral; this same artifice underlies the various attempts to prove the method of stationary phase for double integrals. A.

535.42 : 535.822

5816. PHASE OBJECT DIFFRACTION PATTERNS IN MICROSCOPES AND MICROWAVE FIELDS. O.Bryngdahl and E.Ingelstam.
Physica, Vol. 24, No. 6, 445-56 (1958).

The interpretation of the microscope out-of-focus effect with small, non-absorbing, phase objects is theoretically attempted and analogous experiments with 5.15 cm microwaves made. The Fresnel diffraction is examined even in the immediate neighbourhood of the object, the dimensions of which are of the order of magnitude of the wavelength; and the intensity of radiation in the electric plane behind defined diffracting objects has also been measured. Comparison of the experimental and the theoretical curves shows a satisfactory agreement. A.

535.434

5817. SCATTERING OF LIGHT BY SPHERICAL PARTICLES WITH A REFRACTIVE INDEX m = 1.33. L.Houziaux and L.Battiau.
Mem. Acad. Roy. Belgique, Cl. Sci. (Coll. in 4°), Vol. 14, No. 4, 33 pp. (1958).

Values of the mean intensity functions of the Mie scattering theory were computed for three simple size distribution functions and for the following values of the parameters: M = 1.33; x : 0(0.4)5.2; θ : 0°(10°)180°. The degree of polarization is also given in the tables. A.

535.515 : 548.736.1

5818. CALCULATIONS ON THE DOUBLE REFRACTION OF SOLID HELIUM. R.Kronig and R.K.M.Sonnen.
Physica, Vol. 24, No. 6, 432-6 (1958).

The double refraction of solid helium, which crystallizes in a hexagonal lattice, is computed as a function of the ratio c/a of the lattice parameters in a range about the value 1.633 corresponding to closest packing of spheres. The atoms are assumed to be isotropic as regards their optical scattering. The lattice sums are evaluated by the method of Ewald. The results permit to determine the ratio c/a from double refraction measurements with greater precision than is possible by X-ray structure analysis. A.

535.551

5819. PHOTOELASTIC PROPERTIES OF POLYSTYRENE IN THE GLASSY STATE. I. EFFECT OF MOLECULAR ORIENTATION. R.D.Andrews and J.F.Rudd.
J. appl. Phys., Vol. 28, No. 10, 1091-5 (Oct., 1957).

The effect of molecular orientation on the stress-optical coefficient of polystyrene at room temperature (24° C) was measured using polystyrene monofilaments with different degrees of orientation. High degrees of orientation were obtained by cold-stretching. The optical measurements were made using a polarizing microscope fitted with a Sénarmont compensator. The stress-optical coefficient shows a strong dependence on molecular orientation, using birefringence as the index of molecular orientation. The stress-optical coefficient appears to decrease linearly v. birefringence, from a value of about +10 brewsters at zero birefringence to a value of about +4 brewsters at −0.04 birefringence. The elastic (Young's) modulus was also measured (in tension) as a function of orientation, and was found to increase nonlinearly with orientation (from 4.3×10^5 lb/in² at zero birefringence to 6.1×10^5 lb/in² at −0.04). A curve of strain-optical coefficient v. orientation was obtained by multiplying stress-optical and modulus values; this decreases nonlinearly and to a somewhat lesser extent than the stress-optical curve (from about +0.03 at zero birefringence to +0.017 at −0.04). The significance of these constants in photoelastic experiments is discussed. A.

535.551

5820. PHOTOELASTIC PROPERTIES OF POLYSTYRENE IN THE GLASSY STATE. II. EFFECT OF TEMPERATURE. J.F.Rudd and E.F.Gurnee.
J. appl. Phys., Vol. 28, No. 10, 1096-100 (Oct., 1957).

The effect of temperature on the stress-optical coefficient of polystyrene was measured at twelve different temperatures from −195° to +24° C using samples of unoriented polystyrene sheet. The stress-optical coefficient appears to decrease with temperature from a value of about +17 brewsters at −195° C to a value of about +10 brewsters at room temperature. The elastic (Young's) modulus of polystyrene was also measured as a function of temperature using a flexural technique and was found to decrease linearly with temperature from 6.36×10^5 lb/in² at −198° to 4.65×10^5 lb/in² at 24° C. A curve of strain-optical coefficient v. temperature was obtained by multiplying stress-optical and modulus values; this curve increases with decreasing temperature from about +0.03 at +24° to +0.073 at −195° C. A.

535.56 : 538.614

5821. A QUANTUM THEORETICAL TREATMENT OF FARADAY ROTATION IN CHROMIUM ALUM AT CENTIMETRE WAVELENGTHS, AND ITS COMPARISON WITH EXPERIMENT.
B.C.Unal, A.Chevalier and T.Kahan.
C.R. Acad. Sci. (Paris), Vol. 246, No. 6, 901-3 (Feb. 10, 1958).
In French.

The treatment is valid for the region of paramagnetic transparency, about the resonance frequency, where spin–spin interaction does not interfere. Values are computed for the rotation produced in a single crystal of chromium alum, and compared with the experimental results obtained with powders. L.E.Cross

535.6

5822. CRITIQUE ON THE CALCULATION OF THE QUALITY FACTORS FOR FILTERS. J.T.McLane.
J. Opt. Soc. Amer., Vol. 48, No. 4, 276 (April, 1958).

Functions proposed for use in determining the deviations from the correct colour mixture curves of filter combinations (see Abstr. 2096/1957) are shown to be incorrectly normalized. W.T.Welford

535.65

5823. EVALUATION OF METAMERIC COLORS. G.Wyszecki.
J. Opt. Soc. Amer., Vol. 48, No. 7, 451-4 (July, 1958).

A method is described which allows a quick evaluation of a large number of spectral reflectance (transmittance) curves which with respect to a given light source and the 1931 C.I.E. standard observ produce metameric colours. The method is based on a precalculat set of linearly independent metameric blacks and demonstrated by numerical example. A

535.6

5824. PORTABLE TELESCOPIC VISUAL COLORIMETER. O.E.Miller and A.J.Sant.
J. Opt. Soc. Amer., Vol. 48, No. 7, 474-9 (July, 1958).

A compact, portable, visual, telescopic colorimeter has been designed for use in studies of photographic colour reproduction. Telescopic viewing permits measurement of the colour and luminance of areas as small as $\frac{3}{8}$ in. square. Alternative Maxwellian viewing is provided for measuring nonuniform samples or samples having a rough or grainy texture. The precision and accuracy of this instrument were found to be highly satisfactory. A

535.7

PHYSIOLOGICAL OPTICS. VISION. See under "Medical science. Human physiology". Decimal classification 612.84

535.8

5825. FREE SURFACE OF LIQUIDS AS AN OPTICAL ELEMENT M.J.Block and M.Harwit.
J. Opt. Soc. Amer., Vol. 48, No. 7, 480-2 (July, 1958).

A new type of optical element using the free surface of a liquid having an arbitrary surface temperature distribution is described. Besides making arbitrarily deformed surfaces possible, it permits the use of feedback in optical systems. A.

535.81

5826. SELECTION OF OPTICAL GLASSES IN TAYLOR TRIPLET (SPECIAL METHOD). N.v.d.W.Lessing.
J. Opt. Soc. Amer., Vol. 48, No. 8, 558-62 (Aug., 1958).

A method is described for the choice of glasses in Taylor triplets, in which the glasses of the first and third lenses are identical. By using the conditions for total power, longitudinal chromatic aberration, Petzval sum, transverse chromatic aberration, and good distribution of power between the first and third lenses, the power of the second lens, as well as its deviation divided by the aperture are calculated for different glass combinations. These are compared and the most suitable glass pair selected. Finally the diaphragm, initially assumed to be in contact with the second lens, is shifted to a position where a condition of distortion is also satisfied. A.

535.822.6

5827. AN IMPROVED ORIENTATION STAGE FOR MICROSCOPIC OPTICAL CRYSTALLOGRAPHY. H.C.G.Vincent.
Nature (London), Vol. 181, 693 (March 8, 1958).

The author describes a modification to a previous design of a stage for use in a polarizing microscope. The crystal under examination is placed at the centre of a glass sphere, made in two halves, with a central hollow space. An immersion liquid of appropriate refractive index is used to ensure that the emergent rays suffer no refraction by the sphere. R.W.Fish

535.833

5828. THE APLANATIC MIRROR TELESCOPE. C.Morais.
Atti Fond. Ronchi, Vol. 11, No. 5, 404-20 (Sept.-Oct., 1956).
In Italian.

Formulae are given for the computation of an aplanatic two-mirror telescope. The equations for the reflecting surfaces are exact to the sixth power of the aperture. A numerical example is also given. A.

535.833 : 535.312 : 522.21

5829. SOME CONSIDERATIONS ON AN APLANATIC REFLECTING TELESCOPE. C.Morais.
Atti Fond. Ronchi, Vol. 13, No. 2, 156-62 (March-April, 1958).
In Italian.

A Cassegrain system is studied to find the form of the surfaces needed to correct both spherical aberration and violation of the sine condition. The surfaces are found by solving two equations, one of third-order, the other of second-order. In practical cases of large aperture, zonal errors occur and a method is given for calculating these analytically. R.W.Fish

535.89 : 535.87

5830. METHOD FOR THE GENERATION OF VERY FAST LIGHT PULSES. M.Garbuny, T.P.Vogl and J.R.Hansen.
Rev. sci. Instrum., Vol. 28, No. 10, 826-7 (Oct., 1957).

A method is described in which a visible or i.r. light beam is repeatedly reflected between a rotating and stationary mirror system. The resulting sweep speed is proportional to the number of

such reflections. Light pulses of 4×10^{-8} sec duration were measured. A considerable increase in the sweep speed appears feasible. Various applications of the system are mentioned. A.

HEAT

536.21.08

5831. METHODS OF MEASURING THE THERMAL CONDUCTIVITY OF SOLIDS. A BIBLIOGRAPHY. G.L.Cooper.
Atomic Energy Res. Establ. (Harwell), Inf. Bibl. 104, 10 pp. (1956).

Covers the period since 1945. The references are arranged alphabetically by author. Where the original is in a foreign language, an abstract reference is also given. Some of the entries are very briefly annotated. A.

536.212

5832. INVESTIGATION OF THE THERMAL CONDUCTIVITY OF LEAD TELLURIDE. E.D.Devyatkova.
Zh. tekh. Fiz., Vol. 27, No. 3, 461-6 (1957). In Russian.

Thermal conductivity χ of both n- and p-type PbTe specimens with charge-carriers concentration $n = 10^{17}$-10^{18} cm^{-3} and electron conductivity $\sigma = 60$-1740/ohm cm, was measured in the range from 80° to 450°K. The $\chi(\sigma)$ relationship was linear, and the value of $(\chi-\chi_0)/\sigma$, where χ_0 (obtained by extrapolation) is the value of χ corresponding to $\sigma = 0$, indicated that PbTe is characterized by atomic bonding. It was concluded from the temperature dependence of σ, $1/\chi_0$, thermo-e.m.f. and Hall constant, that the additional thermal conductivity in PbTe cannot be attributed to the transfer of the energy of recombination of holes and electrons, and the exciton mechanism of heat conduction in PbTe is postulated.

M.H.Sloboda

536.212.2 : 536.48

5833. LOW-TEMPERATURE THERMAL CONDUCTIVITY OF SOME COMMERCIAL COPPERS.
R.L.Powell, H.M.Roder and W.M.Rogers.
J. appl. Phys., Vol. 28, No. 11, 1282-8 (Nov., 1957).

Values are given for the thermal conductivity between 4°K and 273°K of six commercial coppers and copper alloys: coalesced, electrolytic tough-pitch, free-cutting (tellurium) and phosphorus deoxidized coppers, free-cutting leaded brass, and silicon bronze A. The first three show the conductivity maximum typical of pure metals; the last three show the monotonic increase characteristic of alloys. The intrinsic thermal resistance in the three purer coppers varies appreciably with the concentration of chemical impurities but is much less affected by physical imperfections. In the heavily worked copper alloys the lattice contribution to the conductivity is minor and the total conductivity is essentially the electronic conductivity as limited by the imperfection scattering. A.

536.212.2

5834. ISOTOPIC AND OTHER TYPES OF THERMAL RESISTANCE IN GERMANIUM. T.H.Geballe and G.W.Hull.
Phys. Rev., Vol. 110, No. 3, 773-5 (May 1, 1958).

The thermal conductivity of a high-purity n-type Ge single crystal grown from 95.8% Ge^{74} was measured down to 2°K to test the effects of isotopic disturbance of the crystal lattice. Comparison with results from a control sample of normal Ge indicated dominant isotopic scattering in normal Ge below about 5°K. Above the temperature of the conductivity maximum, there was evidence for important umklapp scattering. D.Haneman

536.212.3 : 539.17

5835. HEAT CONDUCTION IN CHARCOAL COLUMNS.
E.Glueckauf and R.E.Watts.
Atomic Energy Res. Establ. (Harwell), Mem. C/M 337, 3 pp. (1958).

The coefficient of thermal conductivity of charcoal beds was determined experimentally, also that of charcoal beds containing copper gauze to facilitate heat conduction. A.

536.212.3 : 536.63

5836. SIMULTANEOUS DETERMINATION OF THE THERMAL PROPERTIES OF POOR CONDUCTORS BY A CURRENT IMPULSE [METHOD]. A.Sellerio and M.C.Spitale.
Ricerca sci., Vol. 27, No. 5, 1539-45 (May, 1957). In Italian.

It is shown how by a single experiment it is possible to determine the thermal conductivity, the thermal diffusivity and the volumetric specific heat of an insulating material, whatever its form may be. An instantaneous current is sent along a tin wire pushed into the material and a thermocouple indicates when the temperature at a point in the material reaches a maximum. A.

536.222.07

5837. SPHERICAL APPARATUS FOR MEASURING THE THERMAL CONDUCTIVITY OF LIQUIDS.
V.E.Schrock and E.S.Starkman.
Rev. sci. Instrum., Vol. 29, No. 7, 625-9 (July, 1958).

A thin-film spherical conduction apparatus was designed and constructed for application to relatively viscous liquids, such as hydrocarbon lubricants, over a temperature range from ambient to -100° F and encompassing the solidification temperature. Freedom from the effects of convective heat-transfer was demonstrated experimentally. The absolute accuracy of the measurements made with this instrument is believed to be within 2%. A.

536.23 : 533.7

THERMAL CONDUCTIVITY OF MULTICOMPONENT GAS MIXTURES. See Abstr. 5715

536.33.08 : 537.311.33

5838. ON KONOZENKO'S PAPER "SEMICONDUCTOR BOLOMETERS". M.Markov.
Uspekhi fiz. Nauk, Vol. 62, No. 2, 197-9 (1957). In Russian.

Konozenko's review of foreign work on the subject (Uspekhi fiz. Nauk, Vol. 56, No. 2, 283, 1955) is considered by Markov to be misleading on three main counts: (i) in evaluating the threshold sensitivity of bolometers the time of measurement is completely ignored, (ii) quotations from foreign literature are claimed to be faulty, (iii) statements are made which, on the basis of modern measuring techniques, are not correct. C.R.S.Manders

536.413 : 536.48

5839. THERMAL EXPANSION OF LEAD AT LOW TEMPERATURES. P.N.Dheer and S.L.Surange.
Phil. Mag. (Eighth Ser.), Vol. 3, 665-74 (July, 1958).

Changes of length of a lead rod due to thermal expansion were measured between 4.2° K and 10° K by a heterodyne-beat method in which the changes modify the capacity of a condenser in a resonant circuit. The variation with temperature of the Grüneisen constant γ was deduced; the accuracy was just insufficient to show up the jump in thermal expansion coefficient at the superconducting transition. A.

536.423.15 : 539.18

5840. VAPOUR PRESSURE RATIOS OF $^{14}N\,^{14}N$, $^{14}N\,^{15}N$ AND $^{15}N\,^{15}N$. T.F.Johns.
Proc. Phys. Soc., Vol. 71, Pt 4, 701-3 (April, 1958).

Measurements of the vapour pressure ratios for the above isotopic species show that the vapour pressure differences are proportional, within the limits of experimental accuracy, to the atom per cent of N^{15} present in the enriched sample. This substantiates the prediction of Bigeleisen (Abstr. 942/1956) that the rule of the geometric mean would apply to the nitrogen isotopes. Good agreement is also obtained with the results of Kirshenboum and Urey (Abstr. 1100/1943). H.C.Cole

536.424.1

5841. THERMAL EFFECTS OF THE MARTENSITIC TRANSITION IN SODIUM. D.L.Martin.
Phys. Rev. Letters, Vol. 1, No. 1, 4-5 (July 1, 1958).

Specific heat measurements indicate that the transition found by Barrett (Abstr. 792/1957) involves an energy change of about 100 cal/g-atom. A.R.Stokes

536.453 : 536.52

5842. PRODUCTION AND MEASUREMENT OF HIGH TEMPERATURES. W.Lochte-Holtgreven. ADDENDUM. R.Schall and F.Wecken.
Rep. Progr. Phys., Vol. 21, 312-69, 370-83 (1958).

The article is based mainly upon the study of thermally excited plasmas with temperatures in the range of 10 000-70 000°K. In case of no self-absorption the measurement of these temperatures can be effected by observation of lines or of continuous radiation emitted from the plasma. The study of lines implies both line intensities and line shapes. Following the discussion of the different methods of evaluating temperatures the specific properties of a plasma — viscosity, electrical and heat conductivity — are touched upon. Sections deal with the production of high temperatures, arcs, pulsed discharges and sparks, exploding wires and shock waves, and finally chemical reactions. The temperatures actually obtained, the practical applications, and the limitations of the different approaches are indicated. The methods of temperature measurement presented have been used frequently by many investigators and have proved to lead to reliable results of known accuracy in the temperature range below 10^5 deg K. It is expected that the same methods with minor alterations could be used in the region of temperatures exceeding 10^5 deg K. A.

536.453 : 537.562

A METHOD OF HEATING MATTER OF LOW DENSITY TO TEMPERATURES IN THE RANGE 10^5 TO 10^6 °K. See Abstr. 5074

536.48

5843. THEORY OF EXCITATIONS IN LIQUID HELIUM 4.
F.Takano.
J. Phys. Soc. Japan, Vol. 12, No. 11, 1185-94 (Nov., 1957).

A modified "phonon–roton" model for liquid helium II is proposed and is shown to be connected with the theory of Bose condensation. The method used is a direct extension of the method of "auxiliary variables" used by Bogolyubov and Zubarev, and is equivalent to that used by Bohm and Pines in the theory of an electron gas in metals. The phonon excitation is described in terms of the density operator, and the roton part by the so-called individual coordinates. The elimination of the kinematical interaction leads to the following model: the excitations for long wavelengths are described by phonons, and for short wavelengths by rotons, and the total number of excitations cannot exceed the total number of the particles. The thermal properties of this model agree qualitatively with experimental results. A.

536.48 : 539.18

5844. THE PHASE SEPARATION OF ^{3}He-^{4}He MIXTURES.
D.H.N.Wansink.
Physica, Vol. 23, No. 10, 922 (Oct., 1957).

The excess in Gibbs' free energy (ΔG) of the pure components is derived from the saturation pressures of mixtures of helium isotopes. Denoting the concentration by x, the points at which $\partial\Delta G/\partial x = 0$ are interpreted as states at which the mixtures separate into two phases. Comparison with experimental data on phase separation does not show good agreement. R.Eisenschitz

536.48

5845. A LATTICE MODEL OF LIQUID HELIUM. II.
H.Matsuda and T.Matsubara.
Progr. theor. Phys., Vol. 17, No. 1, 19-29 (Jan., 1957).

The partition function of the lattice model of liquid helium introduced in Pt I (Abstr. 7063/1957) is calculated by making use of the Kikuchi approximation. Setting two parameters, the effective mass $m = 1/7m_0$ (m_0 is the mass of He atom), and the lattice spacing d = 3.1 A, an excellent agreement of the density dependence of λ-temperature with experiment is obtained. The general trend of other thermodynamical quantities calculated is in good accordance with observation. A.

536.48 : 532.7

SPIN OSCILLATIONS IN LIQUID He^3. See Abstr. 5703

536.483 : 538.244.2 : 621.318.3

CRYOGENIC ELECTROMAGNETS. FEASIBILITY STUDY. See Abstr. 5124

536.5.081

5846. THE FREEZING POINTS OF HIGH PURITY METALS AS PRECISION TEMPERATURE STANDARDS. III. THERMAL ANALYSES ON EIGHT GRADES OF ZINC WITH PURITIES GREATER THAT 99.99+%. E.H.McLaren.
Canad. J. Phys., Vol. 36, No. 5, 585-98 (May, 1958).

For Pt II see Abstr. 9660 (1957). Extensive thermal analyses were carried out on eight grades of high purity zinc with the suppliers' analysed impurity contents in the range from < 0.5 to < 70 p.p.m. The liquidus points were intercompared with a precision of about 0.0002 deg C and the alloy melting ranges were examined following different rates of freezing. A melting range parameter may provide a more sensitive index of the purity than the liquidus temperature, since the shape of the melting curve is strongly influenced by segregation of impurities due to coring on freezing. Two grades of Russian high purity zinc have liquidus points and melting ranges so close to those of New Jersey S.P. zinc that it is difficult to discriminate between them using precision resistance thermometry. This shows that a reported discrepancy of about 0.1 deg C in the freezing points of zinc between the Russian and Canadian laboratories is not due to different impurity contents of the zincs that were used. A.

536.51

5847. THE EFFECT OF THE ELECTROMECHANICAL INERTIA OF MIRROR GALVANOMETERS ON THE RESULTS OF THE THERMOMETER TIME-LAG CONSTANT DETERMINATION.
A.I.Rudnaya.
Zh. tekh. Fiz., Vol. 28, No. 3, 674-8 (1958). In Russian.

When the time-lag constant of a thermometer is determined by the conventional method, using a thermocouple and a mirror galvanometer, it is generally assumed that the results of the measurements are not affected by the characteristics of the galvanometer. The present paper shows analytically and experimentally that this assumption is not always justified, and a method is described for determining the time-lag constant which takes into account the effect of the electro-mechanical inertia of the moving parts of the galvanometer. M.H.Sloboda

536.587 : 621.317.72

5848. DESIGN OF SIMPLE RESISTANCE THERMOMETER BRIDGES FOR WIDE-RANGE CONTROL OF LOW TEMPERATURES
R.D.Goodwin.
Rev. sci. Instrum., Vol. 29, No. 6, 497-501 (June, 1958).

To achieve a precision of temperature control in the range from 0.01° to 0.0001°K, it usually is necessary to utilize the greates sensitivity which can be obtained from a simple resistance thermometer bridge. Over the temperature range of T from 1° to 300°K the resistance R of different thermometers may vary from one to thousands of ohms, and R may increase or decrease with T. Sensitivity $|dR/Rdt|$ may vary more than tenfold. As the dominant limitation upon useful sensitivity is thermal dissipation of thermometer power, design parameters are derived which afford optimum practical sensitivity at the amplifier output per unit thermometer power. Quite unsymmetrical bridges are preferable. Different conditions are preferable for the basically different thermometers, pure metals and semiconductors. A.

536.62.088

5849. OBTAINING RATE THERMAL CURVES BY A CAPACITOR METHOD. B.Gregory and G.Bullock.
J. sci. Instrum., Vol. 35, No. 6, 228-9 (June, 1958).

In order to avoid operator fatigue and to ensure reliability in obtaining heating or cooling curves over extended periods a method was devised for use with Zn, in which the charge and discharge currents of a capacitor are measured. A Cambridge Paschen moving-magnet galvanometer was used as the rate galvanometer (it combines high sensitivity and damping independent of the external electrical circuit). Full details are given, together with curves which compare two variants of the method: plotting from direct observations of the rate galvanometer; and measuring the time interval for unit deflection of the Unipivot galvanometer used to measure the temperature of the specimen. The former is considered much the superior. E.H.Dock

536.621.2

5850. DIFFERENTIAL CALORIMETER OF THE TIAN–CALVET TYPE. R.W.Attree, R.L.Cushing, J.A.Ladd and J.J.Pieroni.
Rev. sci. Instrum., Vol. 29, No. 6, 491-6 (June, 1958).

In the microcalorimeter described the galvanometers previously employed have been replaced by a d.c. amplifier, which materially simplifies the construction and operation of the instrument, and allows an electrical analogue integrator to be used that gives directly the heat of reaction. Sensitivity of the instrument in the range from 0.01 to 2 cal is such that measurements can be made with a precision of 1% or better. Measurements were made, under ideal conditions, of 0.002 cal with a standard deviation of 0.1%. A.

536.631

5851. THE SPECIFIC HEATS OF METALS AT LOW TEMPERATURES. D.H.Parkinson.
Rep. Progr. Phys., Vol. 21, 226-70 (1958).

A review of theoretical and experimental work on both the lattice term and the electronic term. The theoretical review includes a discussion of the effect of conduction electrons on the lattice term, and the effect of correlations and electron–lattice interactions on the electronic term. The experimental review covers simple metals, transition metals, superconductors and rare earths. Concludes with a section on experimental techniques. 170 references. R.G.Chambers

THERMODYNAMICS

536.7 : 530.162

5852. ON THE STATISTICAL THERMODYNAMICS OF IRREVERSIBLE PROCESSES. J.Meixner.
Z. Phys., Vol. 149, No. 5, 624-46 (1957). In German.

It is assumed, as a "master equation", that the time rate of variation of a Gibbsian distribution function is linearly related to the departures of the distribution function from its equilibrium value throughout phase space. The kernel appearing in this integral relation contains all the information about macroscopic irreversibility. It is shown that on suitable assumptions the kernel can be separated

into a mechanical part and a stochastic part and that one can eventually obtain (a) the equations of Kramers and Smoluchowski in Brownian motion and (b) the thermodynamic theory of relaxation. The rotating dipole in an electric field is discussed as an example.
R.O.Davies

536.7 : 538.221

5853. THERMODYNAMICS AND MAGNETIC STRUCTURES OF THE ALLOTROPIC MODIFICATIONS OF MANGANESE.
R.J.Weiss and K.J.Tauer.
J. Phys. Chem. Solids, Vol. 4, No. 1-2, 135-43 (1958).

The free energy, entropy and enthalpy of the allotropic modifications of Mn are separated into their magnetic, electronic and lattice components. The energy difference at absolute zero of the various modifications are determined and it is shown that similar to Fe the high temperature body centred modification would be stable again at low temperature if not for the presence of the complicated α- and β-phases. The thermodynamic parameters are consistent with recent ideas on the electronic structure of transition metals and some suggestions are made concerning the presence of these complicated phases. In particular the α-, β- and δ-phases appear related electronically. A.

536.7 : 539.17

COMPOUND NUCLEUS FORMATION AS AN IRREVERSIBLE THERMODYNAMICAL PROCESS. See Abstr. 5335

536.77

5854. THE THERMODYNAMICS OF STEADY CONDUCTION-DIFFUSION-REACTION STATES OF MULTICOMPONENT FLUID SYSTEMS. W.B.Brown.
Trans Faraday Soc., Vol. 54, Pt 6, 772-84 (June, 1958).

A development in the phenomenological theory of irreversible processes is described. It is shown that in the immediate vicinity of thermostatic equilibrium the steady states of a single-phase fluid system of n reacting components subject to constant external forces can be described by a simple thermodynamic field theory which is linear in the independent field variables $\psi_1, \ldots \psi_n$, where $\psi_i = -\mu_i/T$. The field equations are

$$\nabla^2\psi_i^* = \lambda_i\psi_i^* \quad (i = 1, \ldots, n),$$

where the ψ^*s are linear combinations of the Planck potentials ψ_i, and the positive or zero quantities λ_i are the roots of

$$\det(\lambda a_{ij} - b_{ij}) = 0,$$

where a is the positive definite conduction-diffusion matrix and b is a marginal reaction-rate matrix of rank equal to the number of independent reactions. The theory is applied to the conduction of heat through a closed reaction system, and predicts a variation of the thermal conductivity with the width of the system. Since it is mathematically tractable even for complex reaction mixtures, the theory may be useful in discussing biological systems. A.

536.782 : 536.423.4

5855. JOULE–THOMSON PROCESS IN THE LIQUEFACTION OF HELIUM. E.H.Brown and J.W.Dean.
J. Res. Nat. Bur. Stand., Vol. 60, No. 3, 161-8 (March, 1958).

A dimensionless, normalized, correlating function is introduced for the specific enthalpy of helium. Using this function, the consistency of various enthalpy data is determined. These data are then used to obtain curves of helium liquefaction yield in the region of variable specific heat in terms of heat-exchanger efficiency. A.

ELECTRICITY
ELECTROSTATICS. DIELECTRICS

537.2

5856. POTENTIAL AND CAPACITY OF CONCENTRIC COAXIAL CAPPED CYLINDERS. D.Kirkham.
J. appl. Phys., Vol. 28, No. 6, 724-31 (June, 1957).

An exact solution is obtained for the potential in the space between two finite concentric coaxial right circular capped cylinders; and from the potentials an exact solution of the capacity is found. A set of infinite equations is involved but detailed numerical calculations, made for nine different geometries, show that if the ratio of height of the outer cylinder to diameter of the inner cylinder is less than about unity only the first eight equations and the first eight unknowns in them need be considered for obtaining three figure accuracy of the capacity. The theory is correct when the inner cylinder shrinks to a disk and also when the radius of the outer cylinder goes to infinity. Thus the theory yields the capacity for a horizontal disk midway between infinite conducting planes. When the planes become infinitesimally close to the disk the problem becomes two-dimensional, and the three-dimensional capacity expression goes over to an expression obtained by a conformal transformation. A table of coefficients for 1st, 2nd, 3rd, 4th, 6th, and 8th order approximations is given for computing quantities of interest and to show the rapidity of convergence of results for the nine geometries considered. For one of the cases the equipotentials and lines of force are computed and diagrammed. A

537.212 : 538.122 : 518.5

5857. FLUX PLOTTING ANALOG FOR AN AXIALLY SYMMETRIC POTENTIAL FIELD. W.L.Beaver.
J. appl. Phys., Vol. 28, No. 5, 579-82 (May, 1957).

Plots of flux tubes in axially symmetric static field problems are ordinarily obtained by rather tedious methods from plots of the equipotentials. The differential equation for the flux function in circular cylindrical coordinates does not have the same form as Laplace's equation. Hence, an ordinary wedge-shaped electrolytic tank cannot be used directly to plot flux tubes in an axially symmetric potential field. A direct method is described making use of a coordinate system in which Laplace's equation has the same form as the flux equation in the cylindrical system. An electrolytic tank can then be set up which makes use of this coordinate system in plotting equipotentials which are the analogue of the flux tubes in an axially symmetric problem. A.

537.214

5858. A SIMPLE METHOD OF CALCULATING ELECTROSTATIC CAPACITY. C.J.Bouwkamp.
Physica, Vol. 24, No. 6, 538-42 (1958).

Attention is drawn to a simple theorem enabling the evaluation of the electrostatic capacity of certain conductors in free space such as a system of two spheres in contact with each other or a "ring without hole". A.

537.226 : 536.7

THERMODYNAMIC POTENTIAL OF ROCHELLE SALT. See Abstr. 4937

537.226.1

5859. STRUCTURAL COEFFICIENT OF THE INTERNAL FIELD IN FERROELECTRICS HAVING THE PEROVSKITE STRUCTURE.
G.S.Zhdanov, S.P.Solov'ev and Yu.N.Venevtsev.
Kristallografiya, Vol. 2, No. 5, 639-45 (1957). In Russian.

The structural coefficient determines the contribution to the internal field caused by the interaction of dipoles. The available values are reviewed, and the connection is established between the values with the dipoles directed along [001], [011] and [111] in a cubic cell of the perovskite type. The structural coefficient is also calculated for the tetragonal cell of lead titanate. R.F.S.Hearmon

537.226.2 : 537.228.1 : 539.32

5860. DIELECTRIC, ELASTIC AND PIEZOELECTRIC PROPERTIES OF SINGLE CRYSTAL BENZOPHENONE.
A.A.Chumakov, I.M.Sil'vestrova and K.S.Aleksandrov.
Kristallografiya, Vol. 2, No. 5, 707-9 (1957). In Russian.

Benzophenone has the composition $(C_6H_5)_2CO$ and belongs to the point group 22. The following properties were determined: density, melting point, dielectric loss tangent, permittivity, electric strength, elastic stiffnesses, piezoelectric coefficients and coefficients of electromechanical coupling. R.F.S.Hearmon

537.226.2 : 536.631

5861. DIELECTRIC AND THERMAL STUDY OF TRI-GLYCINE SULFATE AND TRI-GLYCINE FLUOBERYLLATE.
S.Hoshino, T.Mitsui, F.Jona and R.Pepinsky.
Phys. Rev., Vol. 107, No. 5, 1255-8 (Sept. 1, 1957).

The dielectric constants ϵ_b of tri-glycine sulphate and tri-glycine fluoberyllate show a pronounced anomaly at the Curie temperature of 48° C and 70° C, respectively. The dielectric constants ϵ_a and ϵ_c are practically temperature-independent. In the vicinity of the Curie point, the square of the spontaneous polarization increases linearly with decreasing temperature. The transition of both salts is of the second order. Measurements of the specific heat as a function of temperature yield $\Delta S = 0.48$ cal/mole degree for tri-glycine sulphate, and $\Delta S = 1.17$ cal/mole degree for tri-glycine fluoberyllate. The results are discussed on the basis of Mueller's thermodynamic theory for ferroelectric transitions. A.

537.226.32 : 537.312.5

5862. TWO LIMITING POINT GROUPS OF SYMMETRY OF POLYCRYSTALLINE PHOTO-ELECTRETS.
I.S.Zheludev and V.M.Fridkin.
Kristallografiya, Vol. 2, No. 5, 705-6 (1957). In Russian.

A method is described for producing adjacent areas of mutually opposed electric polarization directions in thin layers of polycrystalline sulphur. The symmetry of the texture is discussed.

R.F.S.Hearmon

537.228.4

5863. KERR EFFECT IN POLAR LIQUIDS.
D.A.A.S.Narayana Rao.
Trans Faraday Soc., Vol. 54, Pt 7, 954-8 (July, 1958).

An equation for the electro-optical Kerr effect in liquids is developed, taking into consideration the ellipsoidal shape of the molecule. The Kerr constants of seven polar liquids are calculated on the basis of that equation and good agreement with the existing experimental data is found except for nitrobenzene. A.

ELECTRIC CONDUCTION. CURRENTS

537.311.1

5864. ANOMALOUS RESISTIVITY OF CERTAIN MAGNETIC METALS. P.G.De Gennes and J.Friedel.
J. Phys. Chem. Solids, Vol. 4, No. 1-2, 71-7 (1958). In French.

The anomalous resistivity of some rare earth metals, and of alloys like AuMn, Au_3Mn, is studied by assuming a coupling between conduction electrons and atomic spins. The magnitude of the corresponding cross-section is treated as a phenomenological quantity. At high temperatures, the atomic spins are at random, and the conduction electrons have a finite mean free path. At low temperatures, the atomic spins are all aligned and no scattering can occur. Short-range order effects in the spin lattice are analysed in the Born approximation, and shown to be small in most physical situations.

A.

537.311.1 : 537.312.6

5865. PLASMA APPROACH TO METALLIC CONDUCTION.
L.Gold.
Nature (London), Vol. 181, 1316-17 (May 10, 1958).

A simple connection is suggested between superconductivity and plasma oscillations. D.M.Edwards

537.311.1 : 530.162

5866. QUANTUM THEORY OF ELECTRICAL TRANSPORT PHENOMENA. W.Kohn and J.M.Luttinger.
Phys. Rev., Vol. 108, No. 3, 590-611 (Nov. 1, 1957).

The usual theories of electrical conductivity suffer from a number of weaknesses. This paper attempts, on the basis of a simple model, to put the theory on as rigorous a basis as possible. A technique is developed which gives the entire density matrix of the system of charge carriers in the steady state. The model consists of non-interacting free (or Bloch) electrons being scattered by "random" rigid impurity centres. The density matrix is developed in ascending powers of the strength of the scattering potential. The familiar Boltzmann transport equation represents an approximation valid in the limiting cases of very weak or very dilute scatterers. Higher order corrections are given. A.

537.311.1 : 530.162

5867. QUANTUM THEORY OF ELECTRICAL TRANSPORT PHENOMENA. II. J.M.Luttinger and W.Kohn
Phys. Rev., Vol. 109, No. 6, 1892-909 (March 15, 1958).

See preceding abstract. The same model is considered, but the transport equation is obtained in powers of the density of scatterers without restrictions to weak scattering potentials. The expansion involves scattering operators for single centres, pairs of centres, etc., in a manner in many ways analogous to the virial expansion of equilibrium properties. The lowest order terms yield the usual Boltzmann equation. The first correction, in density, to this equation is explicitly given. For the case of spherically symmetric scatterers the solutions of these equations are also obtained. A.

537.311.31 : 539.2

5868. SPIN-DISORDER EFFECTS IN THE ELECTRICAL RESISTIVITIES OF METALS AND ALLOYS. B.R.Coles.
Advances in Phys., Vol. 7, 40-71 (Jan., 1958).

A review of experimental results for the rare earth metals and the transition metals and their alloys, together with their interpretation in terms of spin-disorder scattering. The alloys considered are Au_3Mn, AuMn, Au_2Mn, Ni_3Mn, Ni_3Cr, dilute solid solutions in ferro- and antiferromagnetic metals, and dilute alloys of transition metals in noble metals. The light shed by electrical measurements on the electronic structure of the transition metals is discussed. The author reports new work on the temperature dependence of the resistivity of iron and nickel specimens containing small amounts of impurity. The results agree with the predictions of Mott and Stevens (see Abstr. 1310/1958). 80 references. D.M.Edwards

537.311.31 : 537.32

5869. EFFECT OF THICKNESS ON THE RESISTIVITY AND THERMOELECTRIC POWER OF THIN COBALT FILMS.
F.Savornin.
C.R. Acad. Sci. (Paris), Vol. 246, No. 20, 2866-9 (May 19, 1958). In French.

Significant differences are observed in the thermoelectric power and resistivity measurements of Co films deposited at room temperature and at 175°C, respectively. These are ascribed to differences in the crystal structure of the layers. C.A.Hogarth

537.311.31 : 538.632

5870. MEASUREMENT OF SMALL VARIATIONS OF RESISTANCE APPLICATIONS TO THE MAGNETORESISTANCE OF THIN FILMS.
A.Colombani, P.Huet and C.Vautier.
C.R. Acad. Sci. (Paris), Vol. 246, No. 20, 2869-72 (May 19, 1958). In French.

A low-frequency, low-noise, system is described for observing magnetoresistance effects in thin Bi films. It is found possible to produce Bi layers 2200 A thick, which show a zero temperature coefficient of resistance at 20°C. By averaging a series of such films it is possible to detect small changes of magnetic field of order 0.01 Oe in 15 000 Oe, and it suggests the possibility of a very carefully stabilized magnetic field system. C.A.Hogarth

537.311.31 : 539.217 : 539.2

EFFECTS OF CRYSTAL DEFECTS ON ELECTRICAL RESISTANCE OF METALS AND ALLOYS. See Abstr. 5479

537.311.32 : 537.323

5871. A STUDY OF THE TEMPERATURE DEPENDENCE OF THE ELECTRICAL CONDUCTIVITY AND THERMOELECTRIC POWER OF SILICIDES. E.N.Nikitin.
Zh. tekh. Fiz., Vol. 28, No. 1, 23-5 (1958). In Russian.

The thermoelectric powers α and electrical conductivities σ of MnSi, $MnSi_2$, CoSi, and $CrSi_2$ were measured (−200° to +800°C). The apparatus is described and the results are presented graphically. The observed values of α and σ are similar to those of poor metals.

K.F.Hulme

537.311.33 : 537.529

5872. THE INFLUENCE OF INTERELECTRONIC COLLISIONS ON CONDUCTION AND BREAKDOWN IN POLAR CRYSTALS.
R.Stratton.
Proc. Roy. Soc. A, Vol. 246, No. 1246, 406-22 (1958).

The variation of the electron mobility with an increasing applied field and also the collective dielectric breakdown field, are calculated assuming that interelectronic collisions are sufficiently frequent to determine the energy and momentum distributions of the electron gas. At high temperatures a small increase (by a factor less than 2) and at low temperatures a large decrease (by a factor greater than 10) in the mobility should be observed as the field approaches the breakdown value. It is shown that the mobility variation at high temperatures will be substantially the same if interelectronic collisions are not predominant, but at low temperatures there will be no variation at all. The application of these results to semiconductors, where the electron scattering mechanism is uncertain, is discussed, with special reference to indium antimonide. A.

537.311.33 : 541.183

5873. ADSORPTION AND CHARGE TRANSFER ON SEMICONDUCTOR SURFACES. H.J.Krusemeyer and D.G.Thomas.
J. Phys. Chem. Solids, Vol. 4, No. 1-2, 78-90 (1958).

The concentration of ions and neutral atoms adsorbed on a semiconductor surface, as well as its surface potential, is treated as a function of the pressure of surrounding gases for coverages up to one monolayer, considering the occupation of sites by both ionized and un-ionized atoms. Pure gases and a mixture of two gases, one giving rise to positive, the other to negative adions, are treated. As an example, numerical results are obtained for semiconductors such as ZnO with a large forbidden gap at temperatures below the intrinsic range. For a gas with pressure P_d and with r atoms per molecule which give rise to positive adions and an n-type semiconductor, the adion density is proportional to $P_d^{1/r}$ for very low coverages.

Following a transition region, the coverage becomes proportional to $P_d^{1/3r}$ until degeneracy of the electron gas near the surface further impedes coverage increase. For gases giving rise to negative adions, the behaviour at low coverages is the same as for gases giving positive adions. This region and a transition range are followed by a region where the ion coverage is practically independent of pressure until an inversion layer is formed. From this point on, the behaviour is again similar to that at higher coverage for gases which give positive ions. The evaluation of the energy of electronic levels formed by the gas atoms, the total number of adsorption sites, and the influence of fast states are discussed. A.

537.311.33 : 538.63

5874. EVALUATION OF TRANSPORT INTEGRALS FOR MIXED SCATTERING AND APPLICATION TO GALVANOMAGNETIC EFFECT. A.C.Beer, J.A.Armstrong and I.N.Greenberg.
Phys. Rev., Vol. 107, No. 6, 1506-13 (Sept. 15, 1957).

The Johnson–Whitesell (Abstr. 3303/1953) evaluations of the conductivity integrals for mixed scattering are extended over larger ranges of magnetic field and impurity scattering parameters to allow their application to the high-mobility semiconductors. Values are given for the first thermoelectric integral. Use of the magnetic field dependence of galvanomagnetic and thermomagnetic properties to study charge-carrier scattering is discussed. Applications of the functions in the analysis of Hall effect, Corbino magnetoresistance, and thermomagnetic phenomena as functions of magnetic field are illustrated. A.

537.311.33

5875. ELECTRICAL CONDUCTION VIA SLOW SURFACE STATES ON SEMICONDUCTORS. H.Statz and G.A.deMars.
Phys. Rev., Vol. 111, No. 1, 169-82 (July 1, 1958).

Steady-state and transient conductance of inversion layers created by acetone vapour on silicon n–p–n bars were investigated. The interpretation gives strong evidence that the charge in the outer surface states can move in an electric field. The mobility of the charge is found to be of the order of 10^{-3} cm^2 $volt^{-1}$ sec^{-1} for thick films. The mobility becomes progressively smaller in thinner films. It is found that inversion layers created by mobile charges may be unstable for certain applied voltages — in which case large potential jumps occur where the inversion layer meets the main p–n junction. It is shown that in many cases the inversion layer current is multiplied while flowing through this potential jump. Possible multiplication mechanisms are discussed. A.

537.311.33 : 621.315.59 : 621.317.61

5876. EXPERIMENTAL DETERMINATION OF THE LIFETIME OF MINORITY CARRIERS IN SEMICONDUCTORS.
V.Andresciani and G.Della Pergola
Ricerca sci., Vol. 27, No. 9, 2663-73 (Sept., 1957). In Italian.

The method employs a d.c. circuit, consisting essentially of a Wheatstone bridge. The parallelepiped-shaped sample forms one arm of the bridge and a thin area of its surface is illuminated by a constant flux. By measuring the variation in resistance as a function of the position of the illuminated area, a curve is obtained from which the value of τ can be found. A.

537.311.33

5877. MOBILITY OF ELECTRONS IN NONDEGENERATE SEMICONDUCTORS CONSIDERING ELECTRON–ELECTRON SCATTERING. M.S.Sodha and P.C.Eastman.
Z. Phys., Vol. 150, No. 2, 242-6 (1958).

Spitzer and Härm (Abstr. 3231/1953) investigated the velocity distribution of electrons in the presence of a weak electric field in an ionized gas. Introducing the concept of time of relaxation τ', due to electron–ion and electron–electron scattering, and using the results of Spitzer and Härm, the present authors obtained an expression for τ' which is applicable to semiconductors with little modification. This expression for τ' was used to obtain the mobility of electrons in non-degenerate semiconductors, taking into account scattering by lattice vibrations, electron–ion interactions and electron–electron interactions. A.

537.311.33 : 539.2

5878. EFFECTS OF SCREENING OF A COULOMB FIELD BY FREE CHARGES IN METALS AND SEMICONDUCTORS. I.Z.Fisher.
Zh. tekh. Fiz., Vol. 27, No. 4, 638-50 (1957). In Russian.

A detailed examination of the physical significance of the formal theory of the bound states in a partially screened Coulomb field developed by Fisher and Krilovich (Zh. tekh. Fiz., Vol. 27, No. 6, 1289-93, 1956) showed that, when applied to metals and semiconductors, this theory has to be supplemented by an analysis of the fluctuations of the screening field and the resulting fluctuations of the bound states of electrons and holes. M.H.Sloboda

537.311.33 : 538.632

5879. HALL EFFECT AND ELECTRICAL CONDUCTIVITY OF TRANSITION-METAL DIBORIDES. H.J.Juretschke and R.Steinitz.
J. Phys. Chem. Solids, Vol. 4, No. 1-2, 118-27 (1958).

The room-temperature resistivity and Hall constant of the diborides of the fourth- to sixth-column transition metals and their solid solutions were measured in order to clarify the electronic structure of these compounds. Since the experimental samples, prepared from powders, were usually porous, extrapolation procedures were developed to relate the electrical properties measured on porous samples to those to be expected at full density. The results thus extrapolated indicate that all these compounds have a similar band structure, the substitution of one transition metal for another changing mainly the occupation of the conduction band. This conduction band is of standard shape; it is nearly empty for fourth-column transition metals, and is filled to about one electron per cell upon substituting fifth-column metal. If the band structure of these compounds derives from that of the transition metals, the results suggest that the usual s–d band overlap is here considerably reduced, and that the d-bands are completely filled by the contribution of three electrons from each boron atom. This makes the main conduction band an s-band. Such an interpretation is in accord with a number of other characteristic properties of these compounds. A.

537.311.33

5880. NEW SEMICONDUCTORS.
J.H.Wernick, S.Geller and K.E.Benson.
J. Phys. Chem. Solids, Vol. 4, No. 1-2, 154-5 (1958).

The synthesis of and structural investigations on the compounds $CuPbAsS_3$, $AgAsSe_2$ and $AgSbTe_2$ are reported. Intrinsic energy gaps of the group of compounds are of order 0.8 to 1 eV. A mobility of 1500 cm^2 $volt^{-1}$ sec^{-1} is reported for holes in a single crystal specimen of $AgSbSe_2$ at 23°C. C.A.Hogarth

537.311.33

5881. EFFECTIVE MASS OF ELECTRONS IN GALLIUM ARSENIDE. L.C.Barcus, A.Perlmutter and J.Callaway.
Phys. Rev., Vol. 111, No. 1, 167-8 (July 1, 1958).

The effective mass of electrons in a sample of n-type gallium arsenide was measured by determining the reflectivity in the infrared. The value obtained, $(0.043 \pm 0.005)m_0$, supports the hypothesis that the minimum of the conduction band is at the centre of the Brillouin zone. A.

537.311.33

5882. PREPARATION AND REGENERATION OF CLEAN GERMANIUM SURFACES. S.P.Wolsky.
J. appl. Phys., Vol. 29, No. 7, 1132-3 (July, 1958).

A quartz microbalance capable of detecting weight-changes equivalent to 0.01 monolayer of GeO was used. Weight-changes in Ge samples cleaned by ion bombardment were measured when the samples were exposed to oxygen and then heated to temperatures between 350 and 625°C. It appeared that removal of oxygen by evaporation of GeO during heating did not take place appreciably before temperatures of about 400°C, and at higher temperatures was insufficient to account for the quantities of oxygen apparently removed from the surface at such temperatures according to other experiments. D.Haneman

537.311.33 : 538.63

5883. MAGNETORESISTANCE OF HOLES IN GERMANIUM AND SILICON WITH WARPED ENERGY SURFACES.
J.G.Mavroides and B.Lax.
Phys. Rev., Vol. 107, No. 6, 1530-4 (Sept. 15, 1957).

The series-expansion method described in an earlier paper (Abstr. 2098/1956) was used to obtain expressions for the magnetoconductivity coefficients in the case of warped energy surfaces and low magnetic fields. Using the experimental values of Hall coefficient and conductivity, and assuming a relaxation time of the form $\tau = l\epsilon^{-\lambda}$, where l is a temperature-dependent coefficient, ϵ the energy of the carriers, and λ a parameter which most suitably represents the scattering processes, the magnetoresistance coefficients in p-type germanium and silicon were calculated. The results of these calculations are used to interpret the experimentally derived directional magnetoresistance effects and also the variation of magnetoresistance with magnetic field in these materials. A.

537.311.33

5884. RATE PROCESSES AND LOW-TEMPERATURE ELECTRICAL CONDUCTION IN N-TYPE GERMANIUM. S.H.Koenig.
Phys. Rev., Vol. 110, No. 4, 986-8 (May 15, 1958).

The low-temperature conduction in Ge is characterized by an

ohmic region for fields $E < 0.2$ V/cm, a region of steadily increasing conductivity σ, and then an extremely rapid rise of σ with E, after which the rise becomes less steep. Pulse and d.c. data are obtained at 5 temperatures $< 10^{\circ}$K and also the response time of the change in σ, resulting from a small step voltage superimposed on the bias current, is determined. The experimental data are analysed, but it is not possible to be sure whether the process which limits the extremely rapid rise of σ with E arises from simple bimolecular recombination or the Auger effect. C.A.Hogarth

537.311.33

5885. RECOMBINATION OF THERMAL ELECTRONS IN N-TYPE GERMANIUM BELOW 10°K. S.H.Koenig.
Phys. Rev., Vol. 110, No. 4, 988-90 (May 15, 1958).

The thermal recombination coefficient B_T was determined over the temperature range from 4° to 10°K. The experimental method is described. The large values of τ, the time-constant for change in carrier density after the application of a voltage step-function, are rather large and the capture mechanism is thought to be of the kind involving "giant traps" discussed previously by Lax (Bulletin of the American Physical Society II, Vol. 1, 128, 1956). See also preceding abstract. C.A.Hogarth

537.311.33 : 538.63

5886. INTERPRETATION OF MAGNETOCONDUCTIVITY IN N-TYPE GERMANIUM AND SILICON. R.W.Keyes.
Phys. Rev., Vol. 111, No. 1, 34-5 (July 1, 1958).

The phenomenological magnetoconductance coefficients of a cubic crystal, which were introduced by Seitz, are expressed in terms of the phenomenological magnetoconductance constants of a single valley for energy bands consisting of [111] valleys and of [100] valleys. It is found that the so-called "symmetry conditions" on the magnetoconductance depend on the vanishing in the principal axis directions of the longitudinal magnetoconductance coefficients of a single valley. Combinations of the magnetoconductance coefficients are also found which constitute approximate measures of the transverse magnetoconductivity and the anisotropy of a single valley. A.

537.311.33

5887. MEASUREMENT OF GERMANIUM SURFACE STATES BY PULSED CHANNEL EFFECT. G.Rupprecht.
Phys. Rev., Vol. 111, No. 1, 75-81 (July 1, 1958).

Densities, cross-sections, and activation energies of several fast germanium surface states are inferred from low-temperature conductivity relaxations in a thin diffused surface layer. Relaxations are induced by application of a sudden reverse biasing pulse. The observed rate of change of channel conductance as a function of temperature is analysed in terms of a model wherein the equilibrium surface Fermi level is presumed to remain in close proximity to a trap level. The results indicate the existence of an electron trap 0.24 eV from the conduction band and two hole traps 0.17 eV and 0.22 eV from the valence band. A.

537.311.33

5888. MOBILITY OF ELECTRONS IN GERMANIUM–SILICON ALLOYS. M.Glicksman.
Phys. Rev., Vol. 111, No. 1, 125-8 (July 1, 1958).

The mobility of electrons in germanium–silicon alloys with compositions varying from 0 to 30 atomic % silicon was measured between 77 and 300°K and the contribution of ionized impurity scattering subtracted. The resulting mobility for electrons in the conduction band with (111) symmetry was found to vary with composition as a combination of a constant term and a term varying as $\{\alpha(1-\alpha)\}^{-1}$, where α is the mole-fraction of minority component in the alloy. In the region where either these (111) electrons or electrons in the (100) conduction band are dominating the conductivity, a subtraction of a constant mobility due to scattering by phonons leaves a mobility which varies with temperature as $T^{-0.7}$ to $T^{-0.8}$. Both of these observations are in qualitative agreement with what is to be expected on the basis of present theories for the scattering by disorder. A.

537.311.33 : 537.312.5

5889. LARGE-SIGNAL SURFACE PHOTOVOLTAGE STUDIES WITH GERMANIUM. E.O.Johnson.
Phys. Rev., Vol. 111, No. 1, 153-66 (July 1, 1958).

Studies of the surface photovoltage of germanium were carried out over a considerably wider range of excess carrier densities than previously reported. Ambient induced inversion and accumulation layer surfaces were studied on p- and n-type Ge with resistivities ranging from 1 to 15 ohm cm. The photovoltage was measured with a.c. methods and the excess carrier density was monitored by changes in the specimen conductance. The observed dependence of the photovoltage on the excess carrier density agreed quite well with theory that considers the surface space charge, but neglects charge changes in fast surface states. Comparison of the observed and theoretical curves is believed to give the surface potential to within about one kT/e unit for potentials less than about 8kT/e units, even if the effect of previously reported fast states is neglected. Excursions of the surface potential over the ambient cycle were found to be about the same as those reported for other types of surface measurements. The large signal photovoltage, in the range of surface potentials covered in the present work, is insensitive to fast states having the range of parameters extant in the literature: sensitivity is largely restricted to unreported parameter values. Since no evidence for fast states was observed in the present experiments, it is concluded that the present results are at least consistent with previously reported fast-state parameter values. A

537.311.3

5890. NON-RADIATIVE RECOMBINATION OF ELECTRONS ON IMPURITY CENTRES IN N-TYPE GERMANIUM. V.A.Kovarskiĭ.
Zh. éksper. teor. Fiz., Vol. 33, No. 6(12), 1445-53 (1957). In Russia

Non-radiative ("phonon") recombination of a current carrier on a Coulomb impurity centre in n-type germanium is investigated at helium temperatures. Interaction between an electron and acoustic vibrations of the lattice is taken into account by successive diagonalization of the original Hamiltonian by a unitary transformation. The tensor nature of the effective current carrier mass and also the general expression for the deformation potential are taken into account in the calculations. A

537.311.3

5891. PROBABILITY OF RECOMBINATION CAPTURE OF CURRENT CARRIERS BY FRENKEL DEFECTS IN n-TYPE GERMANIUM. L.S.Smirnov and V.S.Vavilov.
Zh. tekh. Fiz., Vol. 27, No. 2, 427-9 (1957). In Russian.

The authors correlate the number N of Frenkel defects (lattice vacancies and interstitial atoms) due to bombardment by high-energy electrons with the accompanying decrease of the lifetim of the current carriers and derive a formula $\Theta = (1/\tau' - 1/\tau)/Nv_p$, where Θ – capture cross-section pf holes by the newly formed recombination centres, τ' and τ^1 – effective lifetimes after and before bombardment respectively and v_p – velocity of the thermal motion o holes. From the fact that the numerical value of Θ calculated for n-type Ge bombarded with 750 keV electrons was very close to that obtained by Ostroborodova and Kalashnikov (Abstr. 2094/1956) for the capture cross-section of carriers by thermo-acceptors, it is argued that the latter can, in fact, be considered to constitute structural defects. M.H.Slobod

537.311.33 : 539.2

THE EFFECT OF FAST-NEUTRON IRRADIATION ON RECOMBINATION IN GERMANIUM. See Abstr. 5491

537.311.3

5892. THEORY OF THE CYCLOTRON-RESONANCE ABSORPTION BY CONDUCTION ELECTRONS IN INDIUM ANTIMONIDE. R.F.Wallis.
J. Phys. Chem. Solids, Vol. 4, No. 1-2, 101-10 (1958).

A semiclassical theory is presented. It is assumed that the conduction band is a simple band with a minimum at $k = 0$, and spin interactions are neglected. Terms up to the fourth order in the expansion of E in powers of k about the band edge are taken into account in a computation of the energy levels and wave-functions of an electron in a constant magnetic field, using a simplified form of the effective mass equation of Kjeldaas and Kohn in which warping of the conduction-band energy surfaces is neglected. An expression for the absorption coefficient is obtained which is accurate to terms linear in the fourth-order energy coefficient. Collision broadening is incorporated, using a single relaxation time. The fourth-order coefficient in the energy results in a splitting of the cyclotron-resonance absorption band into a series of peaks, each broadened towards the low-frequency side. The frequencies of the maxima of these peaks are shifted towards lower values by an amount which is proportional to the magnetic field and to the fourth-order coefficien in the energy and increases with magnetic quantum number. Using the energy-band parameters computed by Kane, the theoretical frequency shift is larger than that observed in infrared cyclotron-resonance experiments, but it is of the right order of magnitude. A

537.311.33 : 538.6

5893. GALVANOMAGNETIC EFFECTS IN n-TYPE INDIUM ANTIMONIDE. H.P.R.Frederikse and W.R.Hosler.
Phys. Rev., Vol. 108, No. 5, 1136-45 (Dec. 1, 1957).

The magnetic field dependence of the magnetoresistive effects and the Hall coefficient were investigated at 78°K and at liquid helium temperatures. Results at very low magnetic field strength are in agreement with assumption of an isotropic conduction band. Quantization of the electron orbits causes deviations from the conventional theory at large fields (of the order of a few thousand gauss and higher). Oscillations in the magnetoresistance observed at 4.2°K and lower are attributed to these quantum effects. The measured period of oscillation agrees reasonably well with theoretical predictions. An effective mass value of 0.01 m_0 is obtained from the field and temperature dependence of the amplitude of the oscillations. The magnitude of the magnetoresistive effects appears to depend considerably on the geometry and inhomogeneity of the sample. Strong magnetic fields also influence the distribution of "free" and bound electrons, causing a freeze-out effect at temperatures of liquid helium. A.

537.311.33 : 538.63

5894. GALVANOMAGNETIC EFFECTS IN P-TYPE INDIUM ANTIMONIDE. H.P.R.Frederikse and W.R.Hosler.
Phys. Rev., Vol. 108, No. 5, 1146-51 (Dec. 1, 1957).

The conductivity and Hall effect of p-type InSb were measured as a function of magnetic field strength and of temperature. The behaviour of the Hall coefficient and the magnetoresistance at 78°K is consistent with a valence band which consists of two bands with different effective masses and has degenerate maxima at the centre of the Brillouin zone. Negative magnetoresistances were observed at liquid helium temperatures; the effect is positive, however, for very pure samples when the magnetic field strength exceeds ~ 10^3 G. The conduction mechanism in this temperature range is still poorly understood. A.

537.311.33 : 537.27

5895. HIGH ELECTRIC FIELD EFFECTS IN N–INDIUM ANTIMONIDE. M.Glicksman and M.C.Steele.
Phys. Rev., Vol. 110, No. 5, 1204-5 (June 1, 1958).

Pulsed current densities up to 10^4 A/cm^2 were applied to a single crystal specimen at 77°K having no junctions. From the behaviour of the resistance and magnetoresistance in a field of 7000 G, the creation of hole-electron pairs by impact ionization was deduced, the threshold field being about 200 V/cm. D.Haneman

537.311.33

5896. FORBIDDEN-BAND WIDTH IN INDIUM ANTIMONIDE. V.V.Galavanov.
Zh. tekh. Fiz., Vol. 27, No. 4, 651-5 (1957). In Russian.

The fact that, at 0°K the forbidden-band-width in p-type InSb is twice as large as that in n-type InSb (Abstr. 3767/1954), is explained analytically by taking into account the large ratio of the electron and hole mobilities ($u_1/u_2 = b > 1$) in InSb. The theoretical curves showing the temperature dependence of electrical conductivity σ and Hall constant R were in good agreement with the experimental data quoted in the literature, and the slope of the straight portions of the (log σ, 1/T) and (log R, 1/T) curves for p-type InSb in the range of transition from the extrinsic to intrinsic conductivity was twice as large as that of the corresponding curves for n-type specimens in the intrinsic conductivity region. M.H.Sloboda

537.311.33 : 538.632

5897. ON ELECTRICAL RESISTIVITY AND HALL COEFFICIENT OF PbTe CRYSTALS. K.Shogenji and S.Uchiyama.
J. Phys. Soc. Japan, Vol. 12, No. 3, 252-8 (March, 1957).

Measurements were made on p-type synthetic crystals, before and after heat treatment in air, at various temperatures down to liquid air temperature. After heat treatment at moderate temperatures the resistivity and Hall coefficient increased. An analysis of the Hall coefficient data shows that the intrinsic energy gap is about 0.3 eV, and the mobility ratio about 2.5 at 300°–400° K. The activation energy of the acceptor levels is very small. The mobility of the hole is approximately proportional to $T^{-3/2}$; this is discussed. A.

537.311.33

5898. STUDY OF THE ELECTRICAL PROPERTIES OF MERCURY TELLURIDE. J.Lagrenaudie.
J. Chim. phys., Vol. 55, No. 3, 175-6 (March, 1958). In French.

Samples were prepared by heating the mercury and tellurium at 650°C in sealed quartz tubes. The band gap found from optical absorption was about 0.15 eV. Conductivity and Hall effect measurements at room temperature indicated electron mobilities up to 25 000 cm^2 V^{-1} sec^{-1}. D.Haneman

537.311.33

5899. LIFETIME AND NICKEL PRECIPITATION IN SILICON. W.J.Shattes and H.A.R.Wegener.
J. appl. Phys., Vol. 29, No. 5, 866 (May, 1958).

The observed carrier-lifetime improvement in silicon after nickel plating and heat treatment was investigated by transmission infrared photography of sample slices of Si so treated. Lines of nickel precipitate were found, apparently nucleated by dislocations, suggesting the possible role of the latter in lifetime degradation. D.Haneman

537.311.33 : 538.222/.224

MAGNETIC PROPERTIES OF N-TYPE SILICON.
See Abstr. 5119

537.311.33 : 621.315.59

5900. THE EVOLUTION OF THE THEORY FOR THE VOLTAGE–CURRENT CHARACTERISTIC OF P-N JUNCTIONS. J.L.Moll.
Proc. Inst. Radio Engrs, Vol. 46, No. 6, 1076-82 (June, 1958).

The rectifying action in semiconductor p-n junctions is controlled essentially by the equilibrium densities, diffusion constants, and recombination times of minority carriers. The low-level behaviour of germanium junctions at room temperature is adequately described by a theory which is based on the rate of diffusion and recombination of minority carriers on either side of the barrier region. It is necessary to include the effects of carrier recombination and generation in the barrier region to explain the low-level behaviour of silicon. At high current densities, the junctions depart from the ideal low-level rectifier law because of effects associated with majority carrier modulation. As a consequence of recombination current to the barrier region at low levels and conductivity modulation effects at high levels, the simple $I_S \exp(qV/kT-1)$ behaviour is rarely observed in silicon junctions at room temperature. A.

537.311.33

5901. PERIPHERAL INHOMOGENEITIES OF THE ALLOYED GERMANIUM P–N JUNCTION. M.Kikuchi.
J. Phys. Soc. Japan, Vol. 12, No. 2, 133-9 (Feb., 1957).

It was found out that the local photocurrent is not homogeneous on the periphery of an alloyed germanium p–n junction, but peaks appear at some positions. These peaks appear even for relatively low reverse bias voltages and some of them disappear when the voltage is increased. When the bias voltage exceeds a certain value, another peak appears. There is a remarkable difference between these peaks in voltage dependency of the local photocurrent. Experimental results on these photocurrent peaks and other related phenomena are given. A.

537.311.33 : 621.382

5902. POINT-CONTACT GERMANIUM TRIODES WITH SHORT MINORITY CURRENT-CARRIER LIFETIME. A.N.Kvasnitskaya, É.B.Mertens, E.G.Miselyuk and A.I.Skopenko.
Zh. tekh. Fiz., Vol. 27, No. 3, 437-40 (1957). In Russian.

To investigate the means of shortening the "turn-off" times, which set the limit for the application of the point-contact triodes in pulse circuits, the authors studied variation of the "turn-on" and "turn-off" times (t_n and t_s resp.) with the effective lifetime T_{eff} of the current carriers, distance l between the emitter and the collector, and the current-carrier injection level (emitter current pulse i_e), using n-type Ge with resistivity 2-4 Ω cm and T_{eff} varying from > 10-15 to < 0.3-0.5 μsec. The results indicate that the process of decay of the collector current is determined by different factors at high and low injection levels. In the latter case (i_e = 1 mA), t_s is determined mainly by transit time dispersion and at low l = 40 μ is practically independent from T_{eff}. At high injection level (i_e = = 5-60 mA) t_s increases with increasing T_{eff} and i_e, and is practically not affected by variation of l, i.e. by transit time dispersion. M.H.Sloboda

537.311.33 : 621.382

5903. A STUDY OF THE CHARACTERISTICS OF WAFER-TYPE GERMANIUM DIODES. V.E.Kosenko.
Zh. tekh. Fiz., Vol. 27, No. 3, 452-60 (1957). In Russian.

Static and dynamic characteristics of p–n junctions formed by diffusing Sb on p-type Ge were investigated at −60 to +60°C. The conductivity σ of the diodes in the forward direction was considerably higher than that of Ge wafers and increased with increasing current. Non-uniform distribution of σ across the thickness of the diodes was observed, and at high currents σ reached its maximum at the barrier layer. At constant voltage, forward current i depended on thickness d of the diode according to $i \sim d^{-2}$. The relationship between i and voltage v had the form $i \sim (v - v_k)^m$, where v_k = diffusion potential, the observed values of m varying between 1 and 2. As

predicted by theory, current–voltage curves for various temperatures intersected at v = 0.6-0.8 V. In the saturation region of the reverse current, variation of the differential resistivity R_D and capacitance C followed the laws $R_D \sim v^{1/3}$ and $C \sim v^{-1/3}$. All experimental results confirmed the theory of p–n junctions formulated by Rashba and Tolpygo (Abstr. 1303/1957). M.H.Sloboda

537.311.33

5904. CRACK-FREE ALLOYED JUNCTIONS IN SILICON USING PURE ALUMINUM. T.C.Taylor.
J. appl. Phys., Vol. 29, No. 5, 865-6 (May, 1958).

Cracks round aluminium–silicon fused junctions due to different thermal expansion coefficients of the Al–Si alloy and Si, were avoided by removal of the molten phase Al–Si alloy from the fusion cavity. This was done by converting it to loose material by reaction with a gold wire, at a temperature below that at which the Al-doped silicon layer recrystallized but before total solidification of the Al–Si alloy. D.Haneman

537.311.33

5905. TWO CHEMICAL STAINS FOR MARKING P-N JUNCTIONS IN SILICON. P.J.Whoriskey.
J. appl. Phys., Vol. 29, No. 5, 867-8 (May, 1958).

One consists of concentrated HF plus illumination, and the other of HF with copper nitrate plus illumination. Reliable and reproducible delineation of junctions is claimed. D.Haneman

537.311.33

5906. IMPROVED DIFFUSION BOUNDARY JUNCTIONS IN SILICON DUE TO SCRATCH-FREE POLISHING. F.Keywell.
J. appl. Phys., Vol. 29, No. 5, 871-2 (May, 1958).

Using angle lap and stain techniques, correlations between surface scratches and junction irregularities were found. Foreign particles on the surface also appeared to be associated with such irregularities. Possible explanations are local changes in the bulk diffusion coefficient, and in the surface concentration of diffusant. D.Haneman

537.311.33

5907. STRUCTURE AND CHARACTERISTICS OF SILICON CARBIDE LIGHT-EMITTING JUNCTIONS. L.Patrick.
J. appl. Phys., Vol. 28, No. 7, 765-76 (July, 1957).

Current–voltage characteristics of SiC p–n junctions were measured on light-emitting samples prepared in such a way as to minimize leakage at the periphery and through "blue spots". The characteristics of such junctions are found to be very different from those previously reported. From the characteristics it is deduced that these junctions have a p–n*–n structure rather than a p–n structure. The high resistivity n* layer is essential for the observed light-emission. This layer, together with the blue spots which short circuit the p–n* junction, determines the form of the reverse characteristic. Two portions of the reverse characteristic take their form from space-charge-limited currents in the n* layer. A theory is given of the forward characteristic of the p–n*–n structure and compared with the experimental current–voltage curve. The theory permits one to obtain a value of the thermal energy gap from a forward characteristic at a single temperature. From a fit of this data the energy gap is found to be 2.83 ± 0.1 eV at room temperature. Results of some experiments on crystal growing are presented and an explanation of the manner of growth of light-emitting junctions is suggested. A.

537.311.62

5908. A THEORY OF AN ANOMALOUS SKIN EFFECT IN METALS. V.P.Silin.
Zh. éksper. teor. Fiz., Vol. 33, No. 5(11), 1282-6 (1957). In Russian.

The phenomenon of an anomalous skin effect is considered using the Landau theory of a Fermi liquid extended by the author (Abstr. 2031/1958) to a degenerate electron liquid. It is shown that the data concerning the Fermi surface obtained in measuring the surface impedance in the region of the anomalous skin effect does not depend on whether the conduction electrons are regarded as a gas or as a degenerate liquid. The question of defining the parameters of an isotropic model of metals is discussed. A.

537.311.62 : 538.221

5909. THE SKIN EFFECT AND FERROMAGNETIC RESONANCE. V.L.Gurevich.
Zh. éksper. teor. Fiz., Vol. 33, No. 6(12), 1497-504 (1957).
In Russian.

Normal and anomalous skin effect in ferromagnetic metals under conditions of ferromagnetic resonance is considered. The constant magnetic field is assumed to be perpendicular to the surface of the specimen. Influence of exchange effects on the width of the resonance line and shift of the resonance frequency are taken into account. A

537.312.5 : 539.2

5910. MAGNETIC ANALYSIS OF X-RAY PRODUCED PHOTO AND AUGER ELECTRONS.
E.Sokolowski, C.Nordling and K.Siegbahn.
Ark. Fys., Vol. 12, Paper 12, 301-18 (1957).

A precision method was developed to determine atomic binding energies by means of magnetic analysis of photoelectrons expelled from thin evaporated layers by X-radiation. The accuracy achieved in the present investigation is of the order of one electron volt, the limits being set essentially by the inherent widths of the atomic levels. The element copper was studied and the K and L_I binding energies found are 8985.5 eV and 1100 eV respectively. Further, the KLL and KLM Auger spectra were investigated. Seven well-resolved lines were obtained in the KLL group. Earlier investigations have given only three KLL Auger lines in copper due to insufficient resolution, whereas theory indicates the possibility of ten lines in this group. Peaks due to electrons which have suffered discrete energy losses are observed on the low energy flanks of the photo lines. A.

537.312.5 : 621.383.4

5911. THE PERFORMANCE OF INFRA-RED PHOTOCONDUCTIVI CELLS. D.H.Roberts and B.L.H.Wilson.
Brit. J. appl. Phys., Vol. 9, No. 7, 291-9 (July, 1958).

Expressions are derived for the responsivity and signal–noise ratio of photoconductive detectors under various conditions of noise limitation. These are used to show the basis for McAlister's relation,(equivalent noise input)/$\tau \cong$ K, and also the reasons for its failure to apply in the case of lead selenide cells. Experimental data obtained on lead selenide cells are presented, and a simple model for the flicker noise is shown to be consistent with the experimental observations. A.

537.312.5

5912. ON THE SCINTILLATION EFFECT IN PHOTOVOLTAIC P-N JUNCTION DIODES. M.Teboul and N.Nifontoff.
C.R. Acad. Sci. (Paris), Vol. 246, No. 18, 2591-4 (May 5, 1958).
In French.

Reports measurements of the resistance and noise power of photosensitive p-n junctions in Ge, as a function of current I through the junction and of the illumination L. The resistance and noise increased with L, and for a fixed L, increased with I to a maximum and then decreased. Detailed effects remain to be explained. D.Haneman

537.312.5 : 535.343

5913. THE STRUCTURE OF SPECTRA OF ABSORPTION AND PHOTOCONDUCTIVITY OF CdS CRYSTALS AT 20°K.
V.L.Broude, V.V.Eremenko and N.N.Chikovani.
Doki. Akad. Nauk SSSR, Vol. 119, No. 5, 911-13 (1958). In Russian.

Optical absorption, κ, was measured to 20 860 cm^{-1} for light polarized parallel, and to 20 680 cm^{-1} for light polarized perpendicular t the c-axis. Above 20 600 cm^{-1} similar spectra were obtained from all crystals, but appreciable local differences in κ were possible at lower frequencies. Comparison is made between features in the absorption spectrum and photoconductivity, e.g. the absorption line near 20 600 cm^{-1} (polarized parallel to c-axis), which may be connected with surface deformation and which was found to vary in strength with different crystals, appeared to have no photoconductivity associated with it. The hypothesis that the photocurrent should be the same for the same value of κ in different parts of the spectrum did not appear to be valid. See also Abstr. 8516 and 9083 (1957) and the following abstract. C.H.L.Goodman

537.312.5 : 535.343

5914. ON THE PROBLEM OF THE STRUCTURE OF THE SPECTRAL CURVE OF THE INTERNAL PHOTOEFFECT IN CdS CRYSTALS. E.F.Gross and B.V.Novikov.
Zh. tekh. Fiz., Vol. 28, No. 4, 782-3 (1957). In Russian.

A brief note on further investigations of photoconductivity (Φ) with polarized light at 77.3°K (see Abstr. 403, 8516/1957 for previous work) which suggest that CdS crystals fall into two groups: those showing peaks in Φ corresponding to optical absorption at 4870 and 4840 A together with broad maxima in Φ near 4795 and 4730 A, and those with minima in Φ for these wavelengths. Infrared background illumination quenched Φ with both groups. C.H.L.Goodman

537.312.5 : 551.521.1

5915. TEMPERATURE CONSIDERATION IN SOLAR BATTERY DEVELOPMENT. R.E.Halsted.
J. appl. Phys., Vol. 28, No. 10, 1131 (Oct., 1957).

Semiconductor materials having a band gap appreciably greater than that of silicon may prove useful for photovoltaic solar energy converters operating at elevated temperatures. Such operation is of interest for applications where solar energy concentration can be employed to reduce the photovoltaic surface area required to produce a desired amount of electrical power. A.

537.312.5 : 535.23.08

5916. HIGH-SENSITIVITY CRYSTAL INFRARED DETECTORS. M.E.Lasser, P.Cholet and E.C.Wurst, Jr.
J. Opt. Soc. Amer., Vol. 48, No. 7, 468-73 (July, 1958).

Germanium infrared detectors are cut from a large zone-levelled crystal. Compensation with antimony donors is used to obtain n-type material. The gold antimony doped detectors have a long wavelength cutoff at 6 microns and a photoconductive time constant which is dependent on the wavelength of the incident radiation. A table is given which shows the sensitivity characteristics of a number of these detectors. Indium antimonide detectors have been made with sensitivities comparable to those of the gold-doped germanium. The indium antimonide detector is made either by alloying or diffusing a thin layer of impurities into the surface layer of a single crystal of material. Cadmium is at present being used, giving a thin p-type surface on n-type indium antimonide. If light is allowed to fall on the front surface of the alloyed material, a photovoltage may be measured between the n and p parts of the detector. The cut-off wavelength for this type of detector when cooled to liquid nitrogen temperature also is of the order of 6 microns. A comparison is made between the characteristics of the two types of cells, and a description is given of a multiple contact cell which can locate a target as well as detect it. A section is included on the standard measuring techniques used in evaluating infrared detectors. A.

537.312.5

5917. PHOTO EFFECTS WITH ANODIC OXIDE LAYERS ON TANTALUM AND ALUMINIUM.
W.C.van Geel, C.A.Pistorius and P.Winkel.
Philips Res. Rep., Vol. 13, No. 3, 265-76 (June, 1958).

Deals with the photoelectric properties of the systems Ta/Ta_2O_5/electrolyte and Al/Al_2O_3/electrolyte during irradiation with ultraviolet light. The electrolyte was replaced by a transparent layer of a metal or a semiconductor. When the system is short-circuits, a photocurrent (i_o) is produced which is proportional to the intensity of irradiation. With a high external resistance a photo-e.m.f. V appears which shows considerable inertia as a function of the time t and which can be written as $V = V_{max}(1 - e^{-kt})$. It appears that k is proportional to the intensity of irradiation. The value of k decreases with increasing thickness (d) of the layer. After correcting for this change of k, which is probably due to absorption, it is found that $i_o d$ = constant. An attempt is made to explain the observed phenomena by assuming that the work function Ta/Ta_2O_5 is smaller that the work function electrolyte/Ta_2O_5. A.

537.312.5

5918. PHOTOELECTRIC CONDUCTION IN KCl CRYSTALS. N.Barth.
Z. Phys., Vol. 149, No. 3, 370-6 (1957). In German.

Irradiation of additively-coloured KCl in the F band at room temperature causes aggregation of the F centres, shown by a number of absorption bands. The spectral and temperature dependence of photoconduction produced by irradiation in the C band is measured. The quantum yield is about one-tenth that for F centres at room temperature. G.F.J.Garlick

537.312.5 : 537.311.33

5919. ON THE CONDUCTION MECHANISM OF CdS SANDWICH CELLS. G.Ecker and J.Fassbender.
Z. Phys., Vol. 149, No. 5, 571-82 (1957). In German.

Using known models of photoconduction in semiconductors a theory of photoconduction in sandwich cells is developed and experimentally verified by measurements on CdS cells. The spectral variation of conductivity and the current–intensity and voltage–current characteristics of cells fit the theory satisfactorily. The results indicate that hole motion and exciton diffusion play little part in the photoconduction in crystals prepared by the authors. C.A.Hogarth

537.312.5

5920. SPECTRAL CHARACTERISTICS OF THE SURFACE PHOTO-EFFECT IN ACTIVATED COPPER–MAGNESIUM ALLOY. V.N.Lepeshinskaya and G.A.Yudaev.
Zh. tekh. Fiz., Vol. 27, No. 3, 502-7 (1957). In Russian.

The surface photo-effect of cathodes prepared from activated 96% Cu, 2% Mg alloy was studied with the aid of photomultipliers. Three multipliers were used, each consisting of 15 multiplying cascades, with all the electrodes made of the investigated alloy and activated at 450, 550 and 600°C in the atmosphere of the residual gases at $\sim 10^{-2}$ mm Hg, the maximum amplification coefficient being $\sim 5 \times 10^3$, 5×10^6 and 10^8 respectively. All three multipliers were characterized by similar photo-effect spectra of a very complex form with the threshhold at ~ 7000 A, a maximum at ~ 5200 A, a sharp minimum approaching zero at ~ 5000 A, and a gradual increase of the photo-effect in the region < 5000 A. The graphically reproduced results are discussed in relation to those obtained by other workers and a detailed description of the experimental technique is given. M.H.Sloboda

537.312.5

5921. COMPARISON OF SOME CHARACTERISTICS OF PHOTO-RESISTORS FSK-M AND FS-K UNDER X-RAY RADIATION. S.V.Svechnikov.
Zh. tekh. Fiz., Vol. 27, No. 4, 656-62 (1957). In Russian.

Sensitivity, dosimetric and current–voltage characteristics, stability of the basic properties, dependence of the photocurrent on the radiation level and the applied voltage, and inertia of CdS photo-resistors prepared from pressed powder (FS-K) were studied and compared with the corresponding properties of photoresistors consisting of single crystals of CdS (FSK-M). The main differences observed were lower sensitivity, lower stability, higher inertia and shorter life of the polycrystalline photoresistors. M.H.Sloboda

537.312.6

5922. ON NON-LINEAR EFFECTS IN METALS AT LOW TEMPERATURES. M.I.Kaganov and V.G.Peschanskiĭ.
Zh. éksper. teor. Fiz., Vol. 33, No. 5(11), 1261-3 (1957). In Russian.

An analysis is given of the possibilities of observing deviations from Ohm's law in metals at low temperatures. A.

537.312.6 : 537.311.1

PLASMA APPROACH TO METALLIC CONDUCTION. See Abstr. 5865

537.312.62

5923. CONDUCTIVITY OF SUPERCONDUCTING FILMS FOR PHOTON ENERGIES BETWEEN 0.3 AND 40 kT_c. R.E.Glover, III and M.Tinkham.
Phys. Rev., Vol. 108, No. 2, 243-56 (Oct. 15, 1957).

Far infrared and millimetre microwave transmission experiments through thin superconducting lead and tin films are reported. The frequency range covered corresponds to photon energies from 0.3 to 40 kT_c. The measurements include the previously unexplored frequency region in which a superconductor changes from an essentially lossless conductor to a normal one. By suitable analysis the effective complex conductivity of the films is obtained from the transmission data. For thin superconducting films it is shown that $[\sigma_1(\omega)-i\sigma_2(\omega)]/\sigma_N$ is, to a good approximation, a universal function of the reduced frequency ($\hbar\omega/kT_c$), being independent of film resistance, thickness, degree of anneal, and material (for the two metals tried). At T = 0, σ_1 appears to be very small (or zero) for photon energies below roughly $3\,kT_c$. Starting at $3\,kT_c$, σ_1 rises rapidly and reaches its limiting value σ_N at about $20\,kT_c$. This behaviour suggests a gap of width $\approx 3\,kT_c$ in the electronic excitation spectrum of the superconducting state. At T = 0 and for photon energies considerably smaller than $3\,kT_c$, $\sigma_2/\sigma_N \approx \alpha kT_c/\hbar\omega$, with $\alpha = 3.7 \pm 0.7$ for both Sn and Pb. The frequency dependence is in agreement with the London theory. This theory, however, would not predict that the results for Pb and Sn should be the same and, moreover, it would give values of $\alpha \sim 100$ times too large. The Pippard nonlocal theory predicts the type of universal dependence found, but with $\alpha = 6.7$. For photon energies of the order of $3\,kT_c$, a polarizability term $\sigma_2'(\omega)$, required by the Kramers–Kronig relations because of the cutoff of $\sigma_1(\omega)$ near $3\,kT_c$, becomes important and tends to cancel the $1/\omega$ term in σ. As a result, σ_2 is reduced to a small value for photon energies above $5\,kT_c$. Some information about the temperature dependence of the complex conductivity has also been obtained. A.

537.312.62

5924. SUPERCONDUCTING ENERGY GAP INFERENCES FROM THIN-FILM TRANSMISSION DATA. A.T.Forrester.
Phys. Rev., Vol. 110. No. 3, 776-8 (May 1, 1958).

It is shown that the infrared transmission results of Glover and Tinkham (preceding abstract) do not determine the form of the superconducting conductivity $\sigma(\omega)$ very closely; in particular, they are compatible with a form of $\sigma(\omega)$ which does not imply the existence of an energy gap. R.G.Chambers

537.312.62

5925. SUPERCONDUCTING ENERGY GAP INFERENCES FROM THIN-FILM TRANSMISSION DATA. M.Tinkham and R.E.Glover, III.
Phys. Rev., Vol. 110, No. 3, 778-9 (May 1, 1958).

A reply to Forrester (preceding abstract). The results are plotted in a new form, which shows the close agreement with the B.C.S. theory and strongly suggests the existence of an energy gap of 3-4 kT_c. R.G.Chambers

537.312.62

5926. NEW METHOD IN THE THEORY OF SUPERCONDUCTIVITY. P.W.Anderson.
Phys. Rev., Vol. 110, No. 4, 985-6 (May 15, 1958).

Outlines a theory in which the Sawada–Brout treatment of correlation energy (Abstr. 400/1958) is generalized by the introduction of pair states and attractive phonon interactions. The results resemble those of the B.C.S. theory (Abstr. 1708/1958), but include correlation and plasma effects explicitly. R.G.Chambers

537.312.62

5927. REMARKS ON THE MEISSNER EFFECT.
M.R.Schafroth.
Phys. Rev., Vol. 111, No. 1, 72-4 (July 1, 1958).

It is shown that a theory of superconductivity which starts from an "effective" Hamiltonian with significantly velocity-dependent interaction between electrons does not possess well-defined magnetic properties. The Meissner effect cannot therefore be established from such a theory. This applies in particular to the Bardeen–Cooper–Schrieffer theory. A.

537.312.62

5928. SUPERCONDUCTING TRANSITION IN ALUMINUM.
J.F.Cochran and D.E.Mapother.
Phys. Rev., Vol. 111, No. 1, 132-42 (July 1, 1958).

Further results on the superconducting properties of aluminium are given which supplement those previously reported (Abstr. 409/1957). The critical field curve for pure Al was measured by using a paramagnetic salt as a thermometer. Except for a region very near T_c, the data are accurately represented by the parabolic relation, $H_c = H_o[1 - (T/T_c)^2]$, where $T_c = 1.196 \pm 0.005^\circ K$ and H_c is about 99 ± 1 gauss. The excellent reproducibility of the S–N transition in Al suggests that it may serve as a useful secondary thermometric standard near $1^\circ K$. Further observations are reported on the broadening tendency of magnetically measured transitions in single-crystal specimens near T_c. It is also found that polycrystalline specimens of the same material do not show the broadening effect. A semiquantitative theory of the intermediate state is applied to explain the observation that the magnetic transition is sharper than predicted on the basis of specimen geometry at temperatures well below T_c. The difference in sharpness can be explained as a contribution of the interphase free energy whose order of magnitude has been estimated with fair success from the observed shape of the magnetic transition. A.

537.312.8

5929. THEORY OF THE SHUBNIKOV–DE HAAS EFFECT.
E.M.Lifshits and A.M.Kosevich.
J. Phys. Chem. Solids, Vol. 4, No. 1-2, 1-10 (1958).

Quantum oscillations of the electrical conductivity $\sigma^{\alpha\beta}$ and the resistivity $\rho^{\alpha\beta}$ tensors are studied using the general formulae of Lifshits (see abstract following). It is shown that the oscillations of $\sigma^{\alpha\beta}$ and $\rho^{\alpha\beta}$ are expressed in terms of oscillations of the magnetic moment in the de Haas–van Alphen effect and the classical values of the mobility tensor. Asymptotes of the oscillation amplitudes in strong magnetic fields are investigated and the simplest cases in which complete calculations of the oscillation amplitudes may be carried out are discussed. A.

537.312.8

5930. QUANTUM THEORY OF THE ELECTRICAL CONDUCTIVITY OF METALS IN A MAGNETIC FIELD. E.M.Lifshits.
J. Phys. Chem. Solids, Vol. 4, No. 1-2, 11-18 (1958).

A kinetic equation is deduced for the statistical operator with general assumptions on the energy spectrum of electrons, and the limit of the transition to a classical case is analysed. Asymptotes of the kinetic coefficients in strong magnetic fields are studied. Starting from the established relationship between the solutions of quantum and classical equations, quantum corrections to the kinetic coefficients, which include resistance and conduction oscillations, are determined. A.

537.312.

5931. QUANTUM THEORY OF LONGITUDINAL MAGNETO-RESISTANCE. P.N.Argyres.
J. Phys. Chem. Solids, Vol. 4, No. 1-2, 19-26 (1958).

An extension of previous work on the effect of quantization of electron orbits in a magnetic field on the lattice relaxation time to include scattering among different oscillator states is made. It is found that the relaxation time is inversely proportional to the density of states in the presence of the magnetic field. The current for a longitudinal electric field is calculated and found to depend, in general, on the magnetic field, in contradistinction to the classical theory, and to present, in particular, an oscillatory behaviour with the magnetic field under degenerate conditions. A.

537.323

5932. THERMOELECTRIC POWER AND RESISTIVITY OF SOLID AND LIQUID GERMANIUM IN THE VICINITY OF ITS MELTING POINT. C.A.Domenicali.
J. appl. Phys., Vol. 28, No. 7, 749-53 (July, 1957).

The thermoelectric power of germanium against platinum was measured between room temperature and $1030^\circ C$ (melting point is $937^\circ C$). Five specimens were studied in the solid phase (three polycrystalline and two single crystalline specimens), and two in the liquid phase (one n type and one p type at room temperature). It is found that the absolute thermoelectric power Q of high purity (50-70 ohm cm) germanium is nearly linear in 1/T only for the range $0.83 < (1000/T) < 1.5$, or $400 < T < 937^\circ C$. The value of Q for these crystals at temperatures below $400^\circ C$ is less negative than would be required by an extrapolation of the straight line $Q = +140 - 280 \times (1000/T)\ \mu V/deg\ C$, which represents fairly well the high temperature data. This discrepancy may be due to the presence of very small amounts of acceptor impurity (perhaps boron) in the crystals. The thermoelectric power between liquid and solid germanium is approximately 70 $\mu V/deg\ C$, and the liquid is posivive relative to the solid. The absolute thermoelectric power of the liquid is very nearly zero and is nearly independent of temperature. Finally, the resistivity of germanium decreases by a factor of approximately 19 upon melting, and is approximately 63 microhm cm in the liquid phase. A.

537.323

5933. MEASUREMENTS OF THERMOELECTRICITY BELOW $1^\circ K$. D.K.C.MacDonald, W.B.Pearson and I.M.Templeton.
Phil. Mag. (Eighth Ser.), Vol. 3, 657-60 (June, 1958).

Measurements on gold and silver down to $0.05^\circ K$ show a thermoelectric power about a thousand times the expected value; it seems impossible to explain this as a "phonon-drag" effect. R.G.Chambers

537.323 : 536.212

5934. THERMO-ELECTROMOTIVE FORCE AND ADDITIONAL THERMAL CONDUCTIVITY OF A STATISTICAL MIXTURE.
S.V.Airapetyants.
Zh. tekh. Fiz., Vol. 27, No. 3, 478-83 (1957). In Russian.

One of the factors determining the efficiency of thermoelectrical devices is $Z = \alpha^2\sigma/\chi$, where α = thermoelectric power, σ = electrical conductivity, and χ = thermal conductivity. To obtain maximum values of Z, alloys constituting complex, pseudo-binary systems in solid solution are used which on melting are subject to both liquation and segregation with the result that thermo-elements prepared by pressing powdered alloys of this type are not homogeneous and can be regarded as statistical mixtures in which various phases are randomly distributed in the form of particles of roughly the same size but characterized by different α, σ and χ. Using Odelevskii's method of calculating the overall values of σ and χ of such mixtures, the author derives a general expression for α of a statistical mixture of an arbitrary number of components, and calculates the increase of the thermal conductivity of such a mixture due to Peltier effect. Values of α calculated for a two-component mixture of PbTe agreed well with the experimental data. M.H.Sloboda

537.323 : 537.311.32

TEMPERATURE DEPENDENCE OF THE THERMOELECTRIC POWER OF SILICIDES. See Abstr. 5871

537.323 : 537.311.31

EFFECT OF THICKNESS ON THE THERMOELECTRIC POWER OF THIN COBALT FILMS. See Abstr. 5869

537.333.71

5935. REFLECTION OF VERY SLOW ELECTRONS.
H.A.Fowler and H.E.Farnsworth.
Phys. Rev., Vol. 111, No. 1, 103-12 (July 1, 1958).

A monoenergetic electron beam from an electrostatic analyser was used to measure reflection coefficients of polycrystalline platinum, single-crystal germanium, and single-crystal copper. The lower limit of primary energy was 0.2-0.3 eV. The contact potential difference between target and collector was measured and compensated by the Kelvin method. Targets were cleaned by heating and argon-ion bombardment. Polycrystalline platinum exhibits a maximum at 2.5 eV, and a rise near zero primary energy attributed to a patch effect. Germanium, after ion-bombardment cleaning, exhibits a low reflection coefficient which decreases to a value between 0.05 and 0.10 at the low-energy limit. Copper, after heating and also after ion-bombardment cleaning, shows a reflection coefficient with weak structure, decreasing nearly to zero at the limit of measurement. These results are in general agreement with the predictions of Herring and Nichols regarding the transparency of surface barriers. Observations were also made on these targets following argon-ion bombardment and exposure to gases. A.

537.363

5936. NOTES ON THE CALCULATION OF ELECTROPHORESIS OF POLYELECTROLYTES WITH PARTIAL FREE-DRAINAGE. H.Fujita.
J. Phys. Soc. Japan, Vol. 12, No. 8, 968-73 (Aug., 1957).

Presents detailed numerical evaluation of the Hermans–Fujita general equation for the electrophoretic mobility of a coiled polyelectrolyte molecule in salt solution. Values of the electrophoretic mobility u_p are obtained as functions of values of two basic parameters σ and β; σ is Debye's "shielding ratio", and β is the radius of the polymer coil relative to the thickness of the diffuse double layer. It is shown that the criticism by Overbeek and Stigter of the validity of the Hermans-Fujita u_p equation is incorrect. A procedure is demonstrated by means of which u_p v. β curves for different fixed values of σ can be reduced approximately to a single curve. The approximate solution for the same problem obtained by Overbeek and Stigter is discussed and compared with the rigorous treatment in relation to this reduction procedure. A.

537.363

5937. CONTRIBUTION TO THE STUDY OF ELECTROPHORESIS ON A SUPPORT. R.Audubert and S.de Mende.
J.Rech. Cent. Nat. Rech. Sci., No. 37, 349-64 (Dec., 1956).
In French.

A study of the effect of evaporation on the hydrodynamic flux, produced a theory in good agreement with experiment. Experiments on the electric field distribution during électrophoresis are described and methods of calculating the absolute mobilities discussed. J.M.Hough

ELECTRIC DISCHARGES

537.521.6

5938. CRITERION FOR VACUUM SPARKING DESIGNED TO INCLUDE BOTH R.F. AND D.C. W.D.Kilpatrick.
Rev. sci. Instrum., Vol. 28, No. 10, 825-6 (Oct., 1957).

An empirical relation is presented that describes a boundary between no vacuum sparking and possible vacuum sparking. Metal electrodes and r.f. or d.c. voltages are used. The criterion applies to a range of surface gradient, voltage, gap, and frequency that extends over several orders of magnitude. Current due to field emission is considered necessary for sparking, but — in addition — energetic ions are required to initiate a cascade process that increases the emitted currents to the point of sparking. A.

537.523.5 : 621.316.5.014.31

5939. MAGNETIC DEFLEXION OF ARCS.
P.E.Secker and A.E.Guile.
Nature (London), Vol. 181, 1615-16 (June 7, 1958).

Measurements of arc movement were made on arcs in air at atmospheric pressure, and for currents up to 700 A. Magnetic fields of 50-500 G were used. The velocity, independent of current, depends on cathode surface conditions. J.D.Craggs

537.525 : 537.562

5940. THE ELECTRON TEMPERATURE AND DEGREE OF IONIZATION IN THE INITIAL STAGE OF A POWERFUL PULSED DISCHARGE. V.I.Kogan.
Atomnaya energiya, Vol. 4, No. 2, 178-80 (1958). In Russian.

Gives formulae for hydrogen, assuming ionization by electrons, with a discharge lasting a few microseconds at pressures of the order of 1 mm mercury. Tables are also given. J.B.Sykes

537.525 : 537.562

5941. ESTIMATION OF THE ELECTRON TEMPERATURE AND DEGREE OF IONIZATION IN THE INITIAL STAGES OF A POWERFUL PULSED DISCHARGE.
N.A.Borzunov, V.I.Kogan and D.V.Orlinskiĭ.
Atomnaya energiya, Vol. 4, No. 2, 180-3 (1958). In Russian.

Complements experimentally the theoretical paper by Kogan (see preceding abstract) for discharges in hydrogen at pressures ~1 mm Hg. The visible spectrum of a cylindrical discharge (chamber diameter 18.5 cm, electrode distance 97 cm, maximum current ~250 kA) was recorded by a photocell which operated an oscillograph. The photocurrent begins to increase when compression begins and reaches a maximum at maximum compression. The total number of quanta emitted is calculated by integration, and thence the electron temperature is calculated according to Kogan's formula. The results show that T_e is almost constant in time but decreases with increasing initial pressure. The degree of ionization is also calculated. J.B.Sykes

537.525.5 : 537.56

GROWING PLASMA WAVES IN LOW PRESSURE MERCURY ARC. See Abstr. 5070

537.525.8 : 535.33.03

5942. INFRARED EMISSION FROM HIGH-FREQUENCY DISCHARGES IN CO_2. D.Cohen, R.Lowe and J.Hampson.
J. appl. Phys., Vol. 28, No. 6, 737-41 (June, 1957).

The infrared radiation at about 2.7 μ and 4.3 μ from the E type glow discharge CO_2, powered by external electrodes at 10 Mc/s, was examined with a lead telluride cell, a lead sulphide cell, and a radiation thermocouple through appropriate filters. The r.f. power was pulsed at 5-30 c/s. The pressure dependence and power dependence of the emitted intensity, and the efficiency of energy conversion to the two infrared bands were measured. The fast photoconductive detectors indicated a radiation decay time of the order of several milliseconds after the pulse cutoff, and the decay half-life was measured as a function of various discharge parameters, and also in the presence of Hg vapour and N_2O. It is concluded that the vibrational states are excited by a purely thermal process, with no significant enhancement due to collisions with slow electrons. A.

537.527.5 : 535.331

THE EMISSION FROM HIGH PRESSURE MERCURY ARCS IN THE "TOTAL" INFRARED. See Abstr. 5771

537.529 : 537.226.2

5943. DIRECTIONAL ELECTRIC BREAKDOWN OF KCl.
R.Cooper and A.Fernandez.
Proc. Phys. Soc., Vol. 71, Pt 4, 688-92 (April, 1958).

Application of a field in the (110) direction to well-annealed crystals led to breakdown along (100) paths at stresses around 0.8 MV/cm. In less well annealed samples breakdown occurred in the field direction, (110), at higher stresses. Application of overvoltages in the form of steep-fronted impulses produced breakdown along (100) paths for stresses below 1.6 MV/cm, but along the field for stresses above 1.6 MV/cm. Some mixed crystals also showed directional breakdown effects. K.W.Plessner

X-RAYS

537.531 : 535.822

5944. A FOCUSING AID FOR THE X-RAY PROJECTION MICROSCOPE. Ong Sing Poen and J.B.le Poole.
Appl. sci. Res. B, Vol. 7, No. 3, 233-48 (1958).

Some of the electrons reflected by the target of an X-ray microscope pass the demagnifying lens in opposite direction and form a magnified image of the focus in the electron source. This secondary image can be caught on a fluorescent screen and observed. The position, shape and size of the image give information on alignment, focusing conditions and image errors. The brightness is a factor 10^3 to 10^4 higher than that of the X-ray fluorescent image under normal focusing conditions. If a magnetic objective is used, centring can be done very accurately (angle of tilt $< 1/600$ radians). In practice this method proves to be very satisfactory, even for voltages as low as 6 kV and less. At these voltages the depth of penetration of the electrons in gold is less than 500 A, so that for a 0.1 μ resolution there is no need for a thin target. A.

537.531 : 535.34

5945. ON THE L_I X-RAY ABSORPTION SPECTRUM OF METALLIC AND VITREOUS SELENIUM AND OF SELENIUM DIOXIDE. L.Rudstrŏm and S.Sjöberg.

Ark. Fys., Vol. 13, Paper 24, 297-302 (1958).

The Se L_I absorption edge of metallic and vitreous selenium and of selenium dioxide is recorded and measured. Close agreement in the shapes of the edges of the vitreous form and the oxide is found while the edge of metallic selenium is somewhat different. The energy shift between the two former edges is 4.2 eV. A.

537.531 : 548

5946. X-RAY PROPERTIES OF PLASTICALLY DEFORMED LiF. L.S.Birks and R.T.Seal.
J. appl. Phys., Vol. 28, No. 5, 541-3 (May, 1957).

Plastic deformation may be introduced in LiF single crystals by abrading, quenching, or bending. For X-ray wavelengths of of about 1.5 A (CuKα) the diffracting power is increased about 4 times by any of the three methods. For shorter wavelengths of about 0.7 A (MoKα) the increase in diffracting power is about 4, 7, and 10 times for abrading, quenching, and bending, respectively. The bent crystals are more effective at shorter wavelengths because the plastic deformation is more uniform throughout the crystal while in the abraded crystal, all the deformation is concentrated in a layer extending only 0.002 in. below the surface. The extent and concentration of plastic deformation is shown by selective etching of dislocation sites. A.

537.531

5947. SPECTRAL INTENSITY DISTRIBUTION OF BREMS-RADIATION. O.Kamada.
Sci. Rep. Tôhoku Univ., First Ser., Vol. 40, No. 3, 152-60 (Dec., 1956).

The spectral intensity of continuous radiation generated by the method of condenser discharge is calculated by assuming that the condenser p.d. decreases with time as if there were a constant resistance across it, and applying in turn the formulae of Kulenkampff (Abstr. 1588/1923) and Nicholas (Abstr. 863/1931) for spectral distribution with a steady voltage. The results are shown as curves of intensity against log λ for several initial voltages. A.R.Stokes

CATHODE RAYS. POSITIVE RAYS

537.533

5948. TRAVELLING WAVE SYSTEMS WITH DIFFERENT PARTICLE WAVE VELOCITIES. L.B.Mullett.
Atomic Energy Res. Establ. (Harwell), Rep. GP/R1742, 7 pp. (1955).

In a linear electron accelerator employing drift tubes, particles of any velocity can be accelerated in a travelling wave fashion by a wave of any velocity (backwards or forwards) by suitable choice of drift-tube length and spacing. For particle velocities from 0.3 to 0.6 c such a system employing a backward travelling-wave appears to be of considerable practical value. A.

537.533 : 537.534

5949. ACCELERATION OF PARTICLES TO COSMIC RAY ENERGIES BY ELECTROMAGNETIC INDUCTION. W.F.G.Swann.
J. Franklin Inst., Vol. 264, No. 4, 287-99 (Oct., 1957).

After some general considerations on the continuous increase of energy of a particle starting from rest in an electromagnetic field, the motion of a particle around a line of force is investigated and a theorem about the lower limits of energy gained along a given path is established. The case of an axially symmetrical field where the vector-potential has no components along the r- or z-directions is considered, and a few cases of particular interest are discussed. When the scale of the phenomena occurring in stars is taken into account, some orders of magnitude of possible energies gained by cosmic-ray particles can be evaluated. G.Martelli

537.533 : 537.534

5950. PROPOSAL FOR A DISTRIBUTED REGENERATIVE ACTION TO EXTRACT THE BEAM FROM A WEAK-FOCUSING SYNCHROTRON BY EXCITING THE RESONANCE: 2 RADIAL OSCILLATIONS/3 REVOLUTIONS . A.Turrin.
Nuovo Cimento, Vol. 8, No. 3, 511-15 (May 1, 1958).

A theoretical derivation of the necessary field configuration, mainly with reference to the 1 GeV synchrotron at Frascati. J.W.Sturgess

537.533 : 537.534

5951. FOCUSING PROCEDURES FOR ELECTROSTATIC ACCELERATORS. C.H.Johnson, J.P.Judish and C.W.Snyder.
Rev. sci. Instrum., Vol. 28, No. 11, 942-8 (Nov., 1957).

Ion optics for Van de Graaff accelerators are reviewed in the elementary terms of geometrical optics, with particular reference to the Oak Ridge 3 MV accelerator. This machine produces well-focused beams of over 100 μA and pulsed peak currents of several hundred μA. The beam diameter measured at a distance of 2.7 tube lengths from the accelerator tube exit decreases from 0.26 in. at 0.38 MV to 0.10 in. at 2.47 MV. The beam divergence at 1.8 tube lengths from the exit is nearly constant, $\cong 2.8 \times 10^{-3}$ rad. The system is analysed in terms of five separate lenses: (1) einzel lens; (2) gap lens; (3) accelerator tube; (4) 90 degree analysing magnet, and (5) strong-focusing lens. It is shown that the cross-overs formed in the gap lens and near the exit of the analysing magnet are of fundamental importance. Brief reference is made to the small energy spread, $\cong 0.025\%$, for the beams obtained from this accelerator in spite of the large control slit spacing demanded by a large cross-over. A

537.533

5952. ON ELECTRON LOSSES DUE TO PHASE OSCILLATIONS INDUCED BY RADIATION FLUCTUATIONS IN SYNCHROTRONS. A.N.Matveev.
Zh. éksper. teor. Fiz., Vol. 33, No. 5(11), 1254-60 (1957). In Russian.

An effective calculation method for electron losses due to phase oscillations induced by radiation fluctuations is presented. Effects of non-linearity are taken into account by means of boundary conditions. A.

537.533 : 533.51/.57

VACUUM EQUIPMENT FOR THE 4 MeV LINEAR ELECTRON ACCELERATOR. See Abstr. 5708

537.533 : 538.56

INTERACTION BETWEEN AN OBLIQUELY INCIDENT PLANE ELECTROMAGNETIC WAVE AND AN ELECTRON BEAM. See Abstr. 5145

537.533.2 : 537.312.5

5953. DELAYED ELECTRON EMISSION AND OUTER PHOTOELECTRIC EFFECT FOR GERMANIUM AFTER ELECTRON BOMBARDMENT. K.Seeger.
Z. Phys., Vol. 149, No. 4, 453-70 (1957). In German.

Bombardment with 300-900 V electrons causes a delayed electron emission, presumably from surface traps. For constant an identical temperatures during bombardment and emission the decay of the latter follows a power law. "Electrical glow curves" are measured and found to be dependent on previous treatment of the specimen. An outer photoelectric effect for visible light is found after bombardment, which decays with time and is strongly temperature dependent. Direct excitation of trapped electrons by light seems less likely than a change in surface-barrier conditions due to light. G.F.J.Garlick

537.533.2

5954. FIELD EMISSION FROM CADMIUM SULPHIDE AND CADMIUM SELENIDE. A.I.Klimin.
Zh. tekh. Fiz., Vol. 27, No. 4, 719-21 (1957). In Russian.

The relationship between the field emission current and the applied potential, the variation of the emission current on raising and lowering the temperature of the emitter, and the effect of illumination on emission were studied in CdSe and CdS specimens. It was concluded that in both cases the field emission is determined by the electron concentration in the conduction band, which accounts also for the connection between field emission and photoconductive phenomena in these materials. M.H.Sloboda

537.533.3

5955. ENERGY SPECTRUM OF A 40 keV ELECTRON BEAM "REFLECTED" BY A METAL OBJECT. F.Pradal and R.Saporte.
C.R. Acad. Sci. (Paris), Vol. 246, No. 20, 2880-3 (May 19, 1958). In French.

The energy spectrum of electrons reflected from typical metal specimens was measured with the aid of a magnetic spectrometer. The specimens represent typical cases encountered in reflection electron microscopy. A.E.I. Research Laboratory

537.533.3 : 537.534.3

5956. ON THE FOCUSING OF CHARGED-PARTICLE BEAMS USING HIGH-FREQUENCY FIELDS. M.A.Miller.
Dokl. Akad. Nauk SSSR, Vol. 119, No. 3, 478-80 (1958). In Russian.

Beams of charged particles can be focused by periodic magnetic and electric fields as shown by Clogston and Heffner (Abstr. 6662/1954). The present paper develops mathematically the conditions to be satisfied by the fields for focusing in the presence of space charg The high frequencies required can be produced in waveguides provided with periodic structures. T.Mulvey

537.533.331

5957. DISTORTION IN WEAK ELECTROSTATIC ELECTRON LENSES. R.Gobrecht.
Exper. Tech. der Phys., Vol. 6, No. 1, 1-10 (1958). In German.

Although much work has been done on the distortion of weak magnetic lenses, little has been done on the analogous case of electrostatic lenses. The paper describes an electron optical arrangement for measuring the distortion. Two immersion lenses were investigated in this way and the Seidel distortion coefficients obtained. T.Mulvey

537.533.331

5958. AN UNCONVENTIONAL ELECTRON LENS. G.D.Archard.
Proc. Phys. Soc., Vol. 72, Pt 1, 135-7 (July, 1958).

An electrostatic lens system is described which is free from primary spherical aberration. The required field distribution is obtained from four non-rotationally symmetric elements. These elements contain either four or eight electrodes. The proposed arrangement is simpler to construct than the one first proposed by Scherzer (Optik, Vol. 2, 114, 1947). T.Mulvey

537.533.35 : 621.385.833

5959. RECENT DEVELOPMENTS IN ELECTRON MICROSCOPY. V.E.Cosslett.
Brit. J. appl. Phys., Vol. 9, No. 7, 253-6, 273-5 (July, 1958).

The new high resolution electron microscopes have made possible the imaging of molecular lattices directly and of metal lattices by the moiré effects they give when superimposed. Dislocations can be observed both in such patterns and also in thin metal foils, in which their motion can be followed by electron cinephotography. In biology the trend is towards critical examination of the various stages in cutting thin sections — fixation, dehydration, embedding and sectioning — to control artefacts and to improve contrast. For this purpose the use of compounds of heavy elements as "electron stains" is being actively explored. Their value is illustrated by a study of the localization of nucleic acid in the cell nucleus and in sperm. Of two new departures in instrument design the first is the development of scanning electron microscopes: recording the scattered electrons shows the surface relief of solid specimens, recording the emitted characteristic X-rays shows the distribution of a particular element. In the second place, electron interference phenomena have been studied in some detail and the first tentative results obtained with a type of electron interference microscope, which would allow the measurement of inner potential as well as the thickness of very thin films. A.

537.533.35 : 621.385.833

5960. THE CHROMATIC FIELD ABERRATIONS AND THEIR CORRECTION IN A THREE LENS REFLEXION ELECTRON MICROSCOPE. D.H.Page.
Brit. J. appl. Phys., Vol. 9, No. 7, 268-70 (July, 1958).

The coefficient of the chromatic difference in magnification for a three-lens reflection electron microscope is found to be a function of the focal length of the intermediate lens and the axial position of the objective aperture. A condition is shown to exist for which the coefficient vanishes and the aberration is then corrected. The coefficient of the chromatic difference in rotation is proportional to the overall rotation of the image and can be minimized by exciting lenses in opposition. The effect on the image of a misalignment of the objective aperture is also dealt with. Tolerances in the settings of the correction conditions for the aberrations and in the alignment of the objective aperture are calculated for typical values of the energy spread in the electron beam at low and high angles of beam deviation. A.

537.533.35

5961. FIELD DESORPTION BY ALTERNATING FIELDS. AN IMPROVED TECHNIQUE FOR FIELD EMISSION MICROSCOPY. E.C.Cooper and E.W.Müller.
Rev. sci. Instrum., Vol. 29, No. 4, 309-12 (April, 1958).

The inclusion of field desorption in field emission microscopy yields additional information on adsorption systems and easily produces clean surfaces of metal tips without the application of heat. An alternating field technique is described using a d.c.-biased a.c. power supply for providing the desorption field during the positive portion of the cycle and allowing the observation of the field electron image during the negative portion. Ion and electron current during one cycle are calculated for a tungsten tip. Patterns from clean nickel, iron and copper are shown. A.

537.533.35 : 539.165.07

5962. ON RELATIVE INTENSITY MEASUREMENTS WITH A TWO-DIRECTIONAL FOCUSING β-SPECTROMETER WITH ENERGY-DEPENDING WINDOW CURVE. K.E.Bergkvist.
Ark. Fys., Vol. 12, Paper 17, 381-97 (1957).

Considering a two-directional focusing β-spectrometer with the opening radially defined in the plane $\varphi = \varphi_z$ an investigation is made of how the measured intensities are affected by a change of the field shape of the spectrometer. The change of the field shape is assumed to be a smooth function of the focused energy. A general expression is obtained which indicates that both the intensity of a conversion line (if defined as the area under the line profile divided by the $B\rho$ value) and the intensity of a continuous spectrum will normally vary only slightly with a change of the field shape. A quantitative estimate of the variation is made for the case when the field change possesses mirror and rotational symmetry and the axial and radial shutters are set symmetrically with respect to the central line. With φ_r fixed at 37^0, it is found that for $\varphi_z = 157^0$ the intensity variation vanishes, while for $\varphi_z = 37^0$ its relative value is approximately equal to the relative change of the field gradient, but with opposite sign. The results are applied to the two-directional focusing spectrometer at the Nobel Institute. Effects of small non-symmetrical field changes are discussed. Reasonably good agreement between the calculated results and the experimental values is obtained. A.

537.533.35

5963. SOME CALCULATIONS OF A TIME-OF-FLIGHT β-SPECTROMETER WITH TROCHOIDAL ORBITS. K.G.Malmfors.
Ark. Fys., Vol. 13, Paper 21, 237-45 (1958).

The trochoidal motion of a charged particle in a magnetic field azimuthally uniform, but with a radial dependence r^{-n}, is calculated in a manner valid in both relativistic and non-relativistic cases. It is found that the azimuthal drift velocity is proportional to the particle energy, so that it becomes reasonable to measure the energies of β-particles from pulsed sources from their flight time. By making $n = 2$, several desirable properties are obtained and the resolution and transmission of a typical instrument would be good. In addition to the main application of this principle to simultaneous β-energy measurements over a wide spectrum, its applications as a pair spectrometer and as a β-energy selector are discussed. A.E.I. Research Laboratory

537.533.71

5964. REFLECTION OF SLOW ELECTRONS FROM THE SURFACE OF PURE TUNGSTEN AND FROM TUNGSTEN COVERED WITH THIN FILMS. II. D.A.Gorodetskiĭ.
Zh. éksper. teor. Fiz., Vol. 34, No. 1, 7-13 (1958). In Russian.

For Pt I see Abstr. 7462 (1956). Reflection of slow electrons from a single crystal of tungsten and from layers of tungsten evaporated onto it was investigated under conditions of ultra-high vacuum ($p < \sim 10^{-9}$ mm Hg) which ensured purity of the surface. A possible explanation of the observed anomalous variation of the reflection coefficient for thin films of Ba, BaO, and Ba—O deposited on tungsten single crystals (reported in Pt I) is discussed. The results are compared with calculations of the reflection of slow electrons from a potential barrier possessing a maximum. Diffraction of slow electrons from single crystals of tungsten and the influence of thin deposited barium films on this phenomenon are discussed. A.

537.533.75

5965. MEASUREMENT OF THE ABSORPTION IN GRAPHITE OF ELECTRONS FROM MUON DECAYS. W.Kusch.
Nuovo Cimento, Vol. 8, No. 5, 762-4 (June 1, 1958).

The absorption of the electrons from μ-meson decays was measured with a counter system to check the theory of the ionization losses of electrons. The results are in agreement, within the limits of experimental error, with the Halpern—Hall formula. S.J.Goldsack

537.533.8 : 537.534.8 : 539.17

5966. ELECTROMAGNETIC RADIATION IN HIGH-ENERGY NUCLEAR INTERACTIONS. N.M.Gerasimova.
Zh. éksper. teor. Fiz., Vol. 33, No. 6(12), 1457-60 (1957). In Russian.

Bremsstrahlung emitted by charged particles participating in high-energy nuclear interactions is computed on basis of the hydrodynamical model of an elementary act. The fraction of radiated energy is found to be constant whereas bremsstrahlung from point charges is found to increase logarithmically with energy. A.

537.533.8

5967. THE BREMSSTRAHLUNG OF ELECTRONS IN AN IONIC FIELD AT THE SHORT-WAVE LIMIT. T.Guggenberger.
Z. Phys., Vol. 149, No. 5, 523-37 (1957). In German.

A general expression in the form of a series is given for the total radiation of an electron in the static field of an ion. The series is evaluated for the short-wave limit in a purely Coulomb field. Then the screening effect of the bound electrons is considered by means of

a shell model, and it is found that for very high initial energies the radiation depends strongly on the parameters introduced into the model. L.Pincherle

537.533.8

5968. THE EFFECT OF REFLECTED ELECTRONS IN SECONDARY ELECTRON EMISSION.
L.N.Dobretsov and T.L.Matskevich.
Zh. tekh. Fiz., Vol. 27, No. 4, 734-44 (1957). In Russian.

Using a new, more accurate experimental technique the authors measured the coefficient of secondary electron emission σ for NaBr, NaI, NaCl, NaF, LiF, SiO_2, Cd_2CO_3 and mica, and showed that the law of similarity does not apply for these dielectrics. The angular dependence of σ was also determined and it was shown that in the case of some materials σ decreased with increasing angle of incidence, when the energy of the primary electrons was $U_p < U_{p\,max}$. The theoretical values of σ calculated for the investigated substances from the experimental data indicate that the effect of the reflected electrons in excitation of the secondary electrons is considerable, and that it should be taken into account when secondary electron emission phenomena are investigated. M.H.Sloboda

537.533.9 : 537.534.9

5969. CONTRIBUTION TO THE THEORY OF TRANSITION RADIATION. G.M.Garibyan.
Zh. éksper. teor. Fiz., Vol. 33, No. 6(12), 1403-10 (1957). In Russian.

Transition and Cherenkov radiation arising when a charged particle moves in succession through two media differing in dielectric and magnetic properties are considered. The cases when the particle enters a medium from vacuum or vacuum from a medium are discussed in detail. A.

537.534

5970. TRAJECTORIES IN THE ACCELERATING AND DRIFT SPACE OF A PROTON INJECTOR.
N.M.King, L.C.W.Hobbis and E.R.Harrison.
Atomic Energy Res. Establ. (Harwell), Rep. GP/R 1748, 5 pp. (1955).

The dynamics of protons in the 500 keV injector for the Harwell proton linear accelerator is outlined, taking account of space-charge effects. The initial beam radius and divergence at the entrance to the accelerator tube, leading to the proper conditions at injection into the linear accelerator, have been calculated for different beam parameters, acceleration lengths, and drift lengths. It is concluded that the acceptance conditions of Tank I may be fulfilled, provided that no serious aberrations are present. A.

537.534

5971. NON-LINEAR EFFECTS IN ALTERNATING GRADIENT SYNCHROTRONS. P.A.Sturrock.
Atomic Energy Res. Establ. (Harwell), Rep. X/R1771, 17 pp. (1955).

A perturbation procedure is applied to an investigation of non-linear effects in the bevatron oscillations of strong-focusing synchrotrons. Quadratic terms in the trajectory equations introduce new instabilities, which make it necessary to avoid further lines in the characteristic-phase diagram, but one is led to expect that higher terms will normally produce few further instabilities. It is suggested that the magnetic field should be shaped so as to satisfy a certain criterion that will guard against the possibility of higher-order instabilities. It is found that, as in the linear problem, only one of the two sets of diagonal lines associated with coupling terms represents possible modes of instability. Results are represented diagramatically in three ways: by invariant contours in the phase plane; by "configuration diagrams", which are convenient transformations of the preceding phase diagrams; and by curves which show how the amplitudes of fixed orbits vary with characteristic phase. Formulae are given which should make it possible to calculate the magnitude of non-linear effects which will arise in a given design subject to prescribed disturbances. A.

537.534

5972. GAS SCATTERING IN PROTON SYNCHROTRONS.
L.B.Mullett.
Atomic Energy Res. Establ. (Harwell), Rep. GP/R 2072, 31 pp. (1956).

A review of experimental and theoretical data is presented, together with new calculations on single scattering loss. Some possible explanations for "minimum aperture" phenomenon and excessive experimental loss are given. A.

537.534

5973. TWIST RESONANCES. M.Bell.
Atomic Energy Res. Establ. (Harwell), Rep. T/R 2077, 26 pp. (1956).

A matrix form of the first order perturbation theory, for stationary values of Q_r and Q_v is given; this confirms the absence of a stop-band in the case of difference resonances, when $(Q_r - Q_v)$ is an integer, and predicts the width of the stop-band at sum resonances, when $(Q_r + Q_v)$ is an integer. A perturbation formula is give for the amplitude of the vertical oscillation set up by moving right through a resonance region. A

537.534

5974. NON-LINEAR EFFECTS IN SPIRAL-RIDGE CYCLOTRONS I. N.M.King and W.Walkinshaw.
Atomic Energy Res. Establ. (Harwell), Rep. GP/R2095, 9 pp. (1957)

Radial orbit stability in the proposed conversion of the 110 in. Harwell synchrocyclotron is analysed on the basis of trajectories computed from a non-linear equation of motion. Emphasis is on the effects due to the $2\pi/3$-mode quadratic resonance, whose influence is found to extend to much lower energies than the 245 MeV estimate on linear theory. The effects are interpreted in terms of the restriction of stable motion to a small region of displacement-divergence phase-space. It is suggested that the difficulties might be overcome by incorporating a small amount of frequency modulation during the final stage of the acceleration. At energies below the resonance region, a further restriction on stable motion may be encountered. This may be explained in terms of a "glancing divergence" and an amplitude; when the orbit variables exceed these, the protons travel along a valley between two ridges, with consequent blow-up. Finally the way in which these data modify the design proposals is discussed and further restrictive effects are anticipated. A

537.534

5975. NON-LINEAR EFFECTS IN SPIRAL RIDGE CYCLOTRONS. II. N.M.King.
Atomic Energy Res. Establ. (Harwell), Rep. GP/R2205, 24 pp. (1957).

Phase plots of median plane orbits are presented and discussed, with particular reference to the proposed conversion of the 110 in. Harwell synchrocyclotron. Non-linear resonances at the $2\pi/3$ and $2\pi/4$ modes in a four-ridged machine, and at the $2\pi/4$ and $2\pi/5$ mode in a six-ridged machine, are shown to lead to restriction on permissible amplitudes of radial oscillation. More complicated effects take place in the regions between resonance modes. It is concluded that successful conversion of the Harwell machine with N = 4 may depend on inhibiting the initiation of large oscillations near the centre, where the $2\pi/4$-mode cubic resonance could lead to severe beam loss. Difficulties in theoretical interpretation of the dynamics in the central region are outlined, and it is suggested that this problem may be solved more satisfactorily by an experimental approach. A study of different types of mean-field law indicates that the best way to incorporate frequency modulation in the conversion may be that suggested in Pt I (see preceding abstract). A.

537.534

5976. AN ANALYTICAL TREATMENT OF NON-LINEAR EFFECTS IN THE SPIRAL RIDGED CYCLOTRON. M.Bell.
Atomic Energy Res. Establ. (Harwell), Rep. T/R2209, 28 pp. (1957).

The $2\pi/3$ and $\pi/2$ resonances, which arise in the radial betatron oscillations in the Harwell cyclotron conversion, are examined, and the phase-plots obtained compared with those found by direct numerical integration of the differential equation. Good agreement is found in the estimation of the range of stable amplitudes near the $2\pi/3$ resonance; for the other resonance the quantitative agreement is poorer although the qualitative features are shown. A.

537.534

5977. VERTICAL MOTION IN SPIRAL-RIDGED ACCELERATORS
J.W.Burren.
Atomic Energy Res. Establ. (Harwell), Rep. T/R 2423, 14 pp. (1957).

The mechanism limiting the growth of vertical oscillations for motion near non-linear coupled resonances in a spiral-ridged accelerator is studied. A method of calculation of the limiting ("turn-over") amplitude is given. The ultimate vertical stability of particles is also studied. A.

537.534

5978. EFFECT OF STRAIGHT SECTIONS ON PARTICLE DYNAMICS IN THE PROPOSED 6.5 GeV SPIRAL-RIDGED SYNCHROTRON. R.Taylor and W.Walkinshaw.
Atomic Energy Res. Establ. (Harwell), Rep. TP/R2174, 4 pp. (1957).

Computations were made on the betratron oscillations in the proposed 6.5 GeV spiral-ridged synchrotron with straight sections. It is found that the frequencies of oscillation vary with amplitude, and in particular pass through the values $\frac{1}{2}$ and 1 corresponding to instabilities, and that the motion becomes unstable for initial vertical displacements quite small relative to the available aperture. It is concluded that the present design is unsatisfactory. A.

537.534

5979. THEORY OF SPIRAL-RIDGED SYNCHROTRONS WITH STRAIGHT SECTIONS. M.J.Mitchell and D.Morgan.
Atomic Energy Res. Establ. (Harwell), Rep. TP/R2175, 18 pp. (1957).

The effect on the betatron oscillations of introducing straight sections into a spiral-ridged synchrotron is considered. Formulae are developed which are shown to be in good agreement with the results of direct computations. In particular, it is shown how, for the proposed synchrotron, the combination of weak radial focusing and fairly strong vertical focusing leads to the phenomenon of multiple, closed orbits, and also to wide variations of frequency of oscillation about these closed orbits. A.

537.534 : 537.56

5980. THE USE OF PLASMA WAVEGUIDES AS ACCELERATING STRUCTURES IN LINEAR ACCELERATORS. L.B.Mullett.
Atomic Energy Res. Establ. (Harwell) Rep. No. GP/R2186, 30 pp. (1957).

Propagation of r.f. waves on plasma rods, with a phase-velocity less than, or equal to, the velocity of light, is discussed in relation to linear accelerators. Conditions are obtained for the achievement of simultaneous phase and radial stability for the accelerated particles. A.

537.534

5981. FOCUSING IN THE PROTON LINEAR ACCELERATOR. II. M.Bell.
Atomic Energy Res. Establ. (Harwell), Mem. T/M128, 10 pp. (1955).

Calculations are presented which take account of the detailed distribution of focusing and defocusing forces (both static and r.f.) over a period of the waveguide. The object is to test the accuracy of previous calculations in which the detailed distribution was replaced by a smoothed-out distribution with the same average value. It is found that the smoothed-out theory is adequate for most purposes. A.

537.534

5982. AZIMUTHAL INHOMOGENEITY IN THE STRONG-FOCUSSING BEVATRON. J.S.Bell.
Atomic Energy Res. Establ. (Harwell), Mem. T/M79, 6 pp. (1957).

It is verified that a statistical spread in the properties of the magnet sectors introduces a band of instability for the betatron oscillations. The width of this band is calculated in general terms; no applications are made to specific systems. A.

537.534

5983. AZIMUTHAL INHOMOGENEITY IN THE STRONG-FOCUSSING BEVATRON. II. J.S.Bell.
Atomic Energy Res. Establ. (Harwell), Mem. T/M86, 3 pp. (1957).

The behaviour of betatron oscillations in the neighbourhood of the stop-bands is examined. The amplitude of oscillation is no longer constant, as in the ideal machine, but beats up and down between certain limits. Formulae are given for these limits and for the frequency of beating. A.

537.534

5984. MINNESOTA 10, 40, AND 68 MeV PROTON LINEAR ACCELERATOR. E.A.Day, R.P.Featherstone, L.H.Johnston, E.E.Lampi, E.B.Tucker and J.H.Williams.
Rev. sci. Instrum., Vol. 29, No. 6, 457-76 (June, 1958).

A description is given of those features of the University of Minnesota proton linear accelerator which extend the design of the Berkeley linear accelerator. These features are: three separate resonant cavities in series which produce, respectively, beams of 10, 40 and 68 MeV protons, as well as appreciable currents, when desired, at energies between 25 and 68 MeV; a 500 kV a.c. injector; a 200 Mc/s amplifier system with three isolated output stages producing 0.6, 2.2 and 3.2 MW of pulsed power; automatic frequency control systems; phase detectors; phase shifters, magnets; shielding and accessory equipment. The characteristics of the output proton beams are described, and a brief mention is made of the experiments being performed. A.

537.534

5985. THE PHYSICAL PRINCIPLES OF MODERN RESONANCE ACCELERATORS. V.I.Kotov, A.B.Kuznetsov and N.B.Rubin.
Uspekhi fiz. Nauk, Vol. 64, No. 2, 197-272 (1957). In Russian.

Survey. The laws of motion of charged particles in magnetic field, auto-phasing, and particle motion in cyclic resonance accelerators are discussed. Besides a detailed discussion of the functioning of the main cyclic machines, there is also a treatment of linear accelerators and a section on strong-focusing accelerators. 84 references (half Soviet). C.R.S.Manders

537.534.1

5986. EQUILIBRIUM DISTRIBUTION OF CHARGES IN A BEAM OF IONS OF LIGHT ELEMENTS.
V.S.Nikolaev, I.S.Dmitriev, L.N.Fateeva and Ya.A.Teplova.
Zh. éksper. teor. Fiz., Vol. 33, No. 6(12), 1325-34 (1957).
In Russian.

The equilibrium distribution of ion charges of light elements with atomic numbers Z between 5 and 10 was studied after passage of the ions through hydrogen, air, argon and celluloid film in a velocity range from 3.5 to $8-11 \times 10^8$ cm/sec. The mean ionic charge $\bar{i}$ was found to be from 10 to 30% larger after traversal of the film of air. The values of $\bar{i}$ in gases were found to differ by 10-20%. The relative amount of ions with a charge $\bar{i}$ in the beam can approximately be expressed by a Gaussian formula. A.

537.534.3 : 539.18

5987. RECONSTRUCTION OF THE ISOTOPE SEPARATOR AT THE NOBEL INSTITUTE OF PHYSICS. T.Alvåger and J.Uhler.
Ark. Fys., Vol. 13, No. 2, Paper 13, 145-63 (1958).

At the Nobel Institute an electromagnetic isotope separator has been working since 1948. It was used for separations of radioactive material for nuclear spectroscopy and preparation of targets of stable isotopes for nuclear reaction studies. Work in the lead region emphasized the importance of better resolution, which was found to be obtainable by using the analysing magnet as a symmetrical sector field. To fulfil the new requirements, an extensive reconstruction of the isotope separator was carried out, including a new vacuum system and lens system. The instrument was made of two-directional focusing type by an electrostatic cylinder lens, with which it is possible to diminish the line height by a factor of 5, or to 10 mm, without any appreciable defocusing. To analyse the focusing properties a partly new method was developed which makes it possible to make continuous observation of the mass lines during the separation. The resolving power obtained is about 1400; the overall efficiency corresponding to this value is a few per cent. A

537.534.3

5988. MASS SPECTROMETER IMAGE DISPLACEMENTS DUE TO SECOND-ORDER ABERRATIONS. C.F.Robinson.
Rev. sci. Instrum., Vol. 29, No. 7, 622-4 (July, 1958).

Second-order aberrations in mass spectrometers give rise to image broadening which is generally unsymmetrical about the optic axis, resulting in a net displacement of the image centre from the optic axis. The net displacement depends on the properties of the mass-resolving system and on the velocity and angular distribution in the ion beam. In the event different ionic species may possess either different mean kinetic energies or different energy distributions, the image shifts may differ appreciably, leading to small but appreciable errors in mass doublet measurements. A.

537.534.3 : 533.52/.54

OIL-FREE PUMPING SYSTEM FOR MASS SPECTROMETERS. See Abstr. 5709

DISCHARGE TUBES. IONIZATION. THERMIONICS

537.542 : 538.56

HIGH-FREQUENCY OSCILLATIONS IN AN ION SOURCE WITH A MAGNETIC GUIDE FIELD. See Abstr. 5136

537.56 : 538.561

5989. OSCILLATIONS IN PLASMA. I.
S.Kojima, K.Kato and S.Hagiwara.
J. Phys. Soc. Japan, Vol. 12, No. 11, 1276-81 (Nov., 1957).

Plasma oscillations were studied using a super-regenerative detector. In discharge tubes similar to Looney–Brown's many plasma oscillations were observed without auxiliary electron beams. When a small beam was introduced into the main plasma, all the oscillations became stronger but their frequencies remain unchanged. For the excitation of plasma oscillations the existence of thick ion sheaths was not necessary. With usual discharge tubes plasma oscillations were detected from the outside of tubes by a small aerial. Many plasma oscillations having slightly different frequencies were always observed. However, details of these oscillations are still obscure. A.

537.56 : 538.561

5990. SUPPRESSION OF PLASMA OSCILLATIONS.
D.W.Mahaffey and K.G.Emeleus.
J. Electronics and Control, Vol. 4, No. 4, 301-4 (April, 1958).

In a 30 mA, 20 V discharge in 1.3×10^{-3} mm of Hg vapour between plane parallel electrodes, plasma oscillations were generated in the region between the anode and a sheet about 6 mm from the cathode, and were studied as a function of current and of anode–cathode distance. When the latter is less than the cathode-to-sheet distance, the oscillations cease but the discharge persists; Langmuir probe measurements showed that a plasma was still present, but no primary electrons with energies greater than the space potential were detected. The critical distance for the disappearance of oscillations varied approximately as $(\text{current})^{-1.6}$.
R.S.Pease

537.56 : 536.453

5991. EXTREMELY HIGH TEMPERATURES.
Nature (London), Vol. 181, 1380-1 (May 17, 1958).

Report of conference sponsored by the U.S.A.F. Cambridge Research Center, and held at Boston (Mass.), 18-19 March 1958. Papers on high temperature plasmas were presented at four sessions: The production of extremely high temperatures; Methods of temperature measurement — optical radiation; Plasma analysis; Applications. R.S.Pease

537.56

5992. PLASMA LOSS FROM MAGNETIC BOTTLES.
E.Persico and J.G.Linhart.
Nuovo Cimento, Vol. 8, No. 5, 740-53 (June 1, 1958).

The various shapes of magnetic fields devised in order to confine a plasma (magnetic bottles) always let part of it leak out, for different reasons. One of the most important of these losses is that due to particles gliding along the lines of magnetic force. In this paper a general method is proposed for evaluating approximately this loss, and it is applied to two particular kinds of magnetic bottles.
A.

537.56

5993. INSTABILITY, TURBULENCE, AND CONDUCTIVITY IN CURRENT-CARRYING PLASMA. O.Buneman.
Phys. Rev. Letters, Vol. 1, No. 1, 8-9 (July 1, 1958).

Considers instabilities caused by Coulomb interactions between particles in fully ionized plasmas and implications to rapid heating in thermonuclear work. C.G.Morgan

537.56 : 538.56

5994. THE OSCILLATION OF A PLASMA ON THE BASIS OF EINSTEIN'S MOMENTUM PRINCIPLE. G.Lampariello.
R.C. Accad. Naz. Lincei, Vol. 22, No. 4, 477-82 (April, 1957).
In Italian.

It is shown for the one-dimensional case that in a plasma the electron velocity is a periodic function of time, no matter how closely it approaches the velocity of light. L.Pincherle

537.56

5995. THE ELECTRICAL CONDUCTIVITY OF A PLASMA. I.
H.Schirmer and J.Friedrich.
Z. Phys., Vol. 151, No. 2, 174-86 (1958). In German.

The Boltzmann transport equation for a plasma of any degree of ionization, in a weak electric field, is solved to the fourth-order of approximation by the use of Sonine polynomials. Electron interaction is not neglected. The electrical conductivity is expressed in a form which requires some quadratures for numerical evaluation.
B.Meltzer

537.56

5996. THE ELECTRICAL CONDUCTIVITY OF A PLASMA. II.
H.Schirmer and J.Friedrich.
Z. Phys., Vol. 151, No. 3, 375-84 (1958). In German.

The rigorous solutions of the Boltzmann transport equation given in Pt I (see preceding abstract) are used to discuss the following topics: determination of scattering cross-sections in a plasma; convergence of the successive approximations to the conductivity; estimation of the effect of electron interaction. B.Meltzer

537.56

5997. AVERAGE ENERGY EXPENDITURE PER ION PAIR IN GASES AND GAS MIXTURES. J.M.Valentine and S.C.Curran.
Rep. Progr. Phys., Vol. 21, 1-29 (1958).

Theoretical and experimental work on the evaluation of w, the average energy expenditure per ion pair, in various gases and gas mixtures is reviewed. Ionization by electrons, α-particles, protons and heavy particles is discussed. A.

537.562

5998. THE THEORETICAL EVALUATION OF THE TOWNSEND COEFFICIENT α/p FOR HYDROGEN. H.A.Blevin and S.C.Haydon.
Austral. J. Phys., Vol. 10, No. 4, 590-4 (Dec., 1957).

Describes a detailed analytical study of calculated values of α/p for hydrogen, and a comparison between the theoretical and the latest experimental values. The agreement is now considerably better at low E/p (electrical field/pressure values) than in the original work of Emeléus, Lunt and Meek. It is necessary to alter the mean energy for a given E/p by a few per cent to obtain good agreement. The implications of this are discussed. J.D.Cragg

537.56

5999. CROSS SECTIONS FOR IONIZATION BY ELECTRONS.
F.W.Lampe, J L.Franklin and F.H.Field.
J. Amer. Chem. Soc., Vol. 79, No. 23, 6129-32 (Dec. 5, 1957).

Cross-sections for ionization by 75 V electrons were measurec for 35 substances (gases) using the ion source of a 21-620 mass spectrometer. Values at variance with those reported by other workers are obtained, and as a consequence reservations concerning the validity of a proposed method of calculating ionization cross sections are expressed. It is found that the measured ionization cross-sections were linearly related to polarizability, and a theoretical rationalization of this relationship is given. A

537.56

6000. IONIZATION IN THE TRAIL OF HIGH-VELOCITY PELLETS. W.S.Partridge and L.D.Harris.
J. appl. Phys., Vol. 28, No. 11, 1269-71 (Nov., 1957).

Aluminium, magnesium, and lithium–magnesium pellets were accelerated to velocities as high as 4.5 km/sec by means of an explosive. The ionization in the trails of these pellets was determinec by measuring the reflection of a microwave signal from the trail. It was found that the ion density in the trail is an increasing function of the velocity and for the velocity range between 1 and 4.5 km/sec lies between 10^{10} and 10^{15} electrons per cm of path. It was observed that aluminium pellets do not produce ionization at velocities below approximately 2.9 km/sec, while magnesium leaves an ionized trail at velocities down to approximately 1.6 km/sec and lithium–magnesium alloy down to approximately 1.3 km/sec. A

537.564

6001. TIME LAG BETWEEN HIGH-SPEED PELLETS AND THE IONIZATION IN THEIR TRAILS. R.A.Davidson and W.S.Partridge.
J. appl. Phys., Vol. 28, No. 11, 1304-8 (Nov., 1957).

An investigation of the spatial relation between high-speed projectiles fired at velocities of from 1 to 2.5 km/sec shows that the ionization and light in their trail does not occur at a point along the projectile path at the same instant the projectile passes. The time lag was measured by letting the projectile and ionization in its trail obstruct the transmission of microwaves through a short length of wave guide. The time lag between the pellet and the ionization was observed for magnesium, aluminium, and titanium projectiles, but attempts to obtain the same data for copper, steel and zinc were unsuccessful because these materials did not seem to produce ionization in their flight at the velocities being investigated. Time lags of up to 1000 μsec were measured at the lower velocities for aluminium projectiles. At velocities of 2.5 km/sec no time lag was observed. That is, the ionization occurred immediately as the pellet passed. Measurements of the luminosity associated with these pelle by means of photocells indicated that the ionization and the luminous region occurred simultaneously. The variations of time lag as a function of velocity is explained by some thermodynamic properties of the metal in the pellet. A.

537.564

6002. IONIZATION BY ULTRA-SPEED PELLETS.
C.D.Hendricks, Jr.
J. appl. Phys., Vol. 28, No. 11, 1339-41 (Nov., 1957).

By reflecting 10 cm microwaves from the trails of ultra-speed pellets, the ion (electron) density in the trails was found to be from 10^9 to 10^{13} electrons per cm of path length. Column diameters were from 1.0 to 7.5 cm and pellet velocities ranged from 1.48 to 2.67 km/sec. The ions apeeared to come from thermal ionization behind the pellet shock waves and from oxidation reactions involving material ablated from the pellets. A.

537.564

6003. CAVITY IONIZATION AS A FUNCTION OF WALL MATERIAL. F.H.Attix, LeR.DeLa Vergne and V.H.Ritz.
J. Res. Nat. Bur. Stand., Vol. 60, No. 3, 235-43 (March, 1958).

A study has been made of the ionization within a flat cavity chamber under irradiation by X- and gamma-rays in the energy region 38 to 1250 keV (effective). Chamber walls were made of carbon, aluminium, copper, tin, and lead, and the wall separation was varied from 0.5 to 10 mm. Results are compared with cavity theory.
A.

537.564

6004. ADSORPTION AND IONIZATION OF SODIUM ON HOT TUNGSTEN. A.M.Romanov and S.V.Starodubtsev.
Zh. tekh. Fiz., Vol. 27, No. 4, 722-33 (1957). In Russian.

Temperature dependence of the ionization current i_p of Na vapour and its current/voltage characteristic at high and low Na vapour pressures were studied by various methods and under various experimental conditions. The anomalous behaviour of Na in comparison with other alkali metals was reflected in the fact that the apparent work function φ_p^{**} determined from the slope of the $\lg i_p = f(1/T)$ curves was higher than the apparent work function φ^{**} determined from the slope of the Richardson graphs $\lg i_e/T^2 = f(4/T)$, where i_e is the electron current from the same W filament. The observed anomalies are attributed to heterogeneity of the surface of the polycrystalline W filaments. M.H.Sloboda

537.565

6005. MEASUREMENTS OF THE MOBILITIES OF THE NEGATIVE IONS IN OXYGEN AND IN MIXTURES OF OXYGEN WITH THE NOBLE GASES, HYDROGEN, NITROGEN, AND CARBON DIOXIDE. E.W.McDaniel and H.R.Crane.
Rev. sci. Instrum., Vol. 28, No. 9, 684-9 (Sept., 1957).

The mobility constants for oxygen negative ions in He, Ne, A, Kr, Xe, H_2, N_2, and CO_2, each containing various partial pressures of O_2 were measured, and extrapolations to zero partial pressure of O_2 were obtained. A measurement of the mobility of the negative ion in 100% oxygen was also made. The value found for the latter was 2.46 ± 0.05 cm^2/(V sec) at S.T.P. It was shown that the mobility values referred to a single species of oxygen ion, but the question as to whether it was O_2^- or O_3^- was not resolved. A time-of-flight method was used, in which the ions were made by the passage of alpha particles through the gas, and detected by a proportional counter. A.

537.572

6006. ON THE IONIZATION OF SOLID PARTICLES. F.T.Smith.
J. chem. Phys., Vol. 28, No. 4, 746-7 (April, 1958).

An extension of the work of Einbinder (Abstr. 5436/1957) to negatively charged particles. The results are presented as a graph of the ratio of true electron density to saturation density (always less than unity) versus inverse temperature. P.Gray

537.572 : 539.12

6007. K-SHELL IONIZATION BY PROTONS. S.Messelt.
Nuclear Phys., Vol. 5, No. 3, 435-46 (Feb., 1958).

The thick-target yield of K-shell X-rays produced when protons of 0.14 to 1.3 MeV energy are stopped in Fe, Cu, Mo, Ag, Sn and Ta was measured with a NaI scintillation spectrometer. The corresponding cross-sections for K-shell ionization were determined. The experimental values for the cross-sections vary less with the atomic number and more with the energy than predicted by theory. An empirical formula, which reproduces with good approximation results reported here and by others, is given. A.

537.583 : 621.385.032.213.13

6008. THERMIONIC AND RELATED PROPERTIES OF CALCIUM OXIDE. B.J.Hopkins and F.A.Vick.
Brit. J. appl. Phys., Vol. 9, No. 7, 257-64 (July, 1958).

Using probe diodes, changes in thermionic emission and conductivity of cathodes of calcium oxide on nickel were followed during activation and poisoning. The effects of material liberated from the anode were studied. The mean nominal thermionic work function is 1.69 eV for the fully activated cathode (from the slope of a Richardson line), with an estimated temperature coefficient of 1.1 mV/deg K. Three regions of conductivity were found; the activation energies for the two at the lowest temperatures are 1.3 and 0.81 eV. The current–voltage characteristics between the cathode base and probe show two types of curvature, one dominant above 625°K and the other below this temperature. A linear relation extending over four orders of magnitude between the logarithms of emission and of the conductivity was observed during activation. Assuming that semiconductor theory may be applied the mean value of the surface work function is calculated to be 0.7 eV. A.

537.583

6009. DONOR DIFFUSION IN OXIDE CATHODES.
R.W.Peterson.
J. appl. Phys., Vol. 28, No. 10, 1176-81 (Oct., 1957).

The activation of oxide cathodes by chemical impurities present in the base nickel is analysed using classical diffusion theory and a model in which the concentration of donors in the oxide particles is controlled by alkaline earth metal adsorbed on the oxide particles. Strong surface adsorption of the alkaline earth metals on the oxide crystal surfaces is indicated. To fit calculated curves of average donor concentration to experimentally observed pulse emission data obtained on Ni with Al as an impurity, surface adsorption energies of 3.2 to 3.4 eV are indicated. A.

537.583

6010. ON THE MECHANISM OF OPERATION OF THE BARIUM ALUMINATE IMPREGNATED CATHODE.
E.S.Rittner, W.C.Rutledge and R.H.Ahlert.
J. appl. Phys., Vol. 28, No. 12, 1468-73 (Dec., 1957).

Emission and evaporation characteristics of a porous tungsten cathode impregnated with the composition $5BaO{\cdot}2Al_2O_3$ are presented and are interpreted in terms of the cathode mechanism. Barium necessary for activation is generated by the reaction,

$$\tfrac{2}{3}\,Ba_3Al_2O_6 + \tfrac{1}{3}\,W = \tfrac{1}{3}\,BaWO_4 + \tfrac{2}{3}\,BaAl_2O_4 + Ba,$$

and is transported through partially clogged pores, the length of which increases with time, predominantly via Knudsen flow. During transport, oxygen is acquired from the tungsten, leading to a substantial content of BaO in the evaporant. The $BaAl_2O_4$ component of the impregnant is inert. Emission is substantially lower than that of an L-cathode, presumably because of release of a poisoning agent accompanying the activator. A.

COSMIC RAYS

537.591

6011. ON THE μ-MESON TELESCOPE USING PLASTIC SCINTILLATORS. S.Kawasaki and Y.Miyazaki.
J. Sci. Res. Inst. (Tokyo), Vol. 52, 1-10 (March, 1958).

A μ-meson detector using plastic scintillators was constructed for the observation of cosmic rays in the Japanese Antarctic Research Expedition. The design and the performance of the telescope are described and some preliminary experimental results are discussed. A.

537.591

6012. ZENITH ANGLE RESPONSE OF A VERTICAL MESON TELESCOPE. R.P.Kane and U.R.Rao.
Proc. Indian Acad. Sci. A, Vol. 47, No. 1, 30-40 (Jan., 1958).

Expressions were obtained for the geometrical sensitivity as a function of the zenith angle of a telescope comprising counter trays of rectangular dimensions. The radiation sensitivity and cumulative sensitivity were also calculated, assuming a zenith angle attenuation of the form $I_\theta = I_0 \cos^2\theta$ for the cosmic-ray intensity. A.

537.591 : 539.1.07

PULSES PRODUCED BY COSMIC RAYS IN PHOTOMULTIPLIERS. See Abstr. 5162

537.591.1

6013. ON THE ENERGY DETERMINATION OF THE HEAVY PRIMARIES. C.M.Garelli, B.Quassiati and M.Vigone.
Nuovo Cimento, Vol. 8, No. 5, 731-9 (June 1, 1958).

The formula suggested by Peters for the energy determination of the heavy primaries requires the knowledge of the mean energy of evaporation of the α-particles. The present work establishes that this energy depends slightly on the size of the evaporating nucleus. A.

537.591.1

6014. IDENTIFICATION OF FAST HEAVY NUCLEI OF THE COSMIC RADIATION USING NUCLEAR EMULSION TECHNIQUES. B.J.O'Brien and J.H.Noon.
Nuovo Cimento, Vol. 8, No. 6, 807-25 (June 16, 1958).

Various workers disagree in their measured charge spectra of the heavy nuclei of the primary cosmic radiation. This disagreement could be due to unreliable charge identification. Since there is inadequate information on comparison of measurement techniques, the authors made measurements of six parameters of tracks of nuclei with $4 \leq Z \leq 9$ in a stack of G-5 stripped emulsion flown at 41°N geomagnetic latitude. The δ-ray, blob, and isolated-grain densities, the Fowler–Perkins coefficient, integral gap length, and probability of development were found for each track. Estimates were made of the effect of various sources of error in these measurements, including a study of the change in each measured parameter with a 20% change in minimum grain density of the emulsion. From the comparison and analysis of these measurements, recommendations are given on the use of the above techniques in the identification of fast heavy nuclei in nuclear emulsion. A.

537.591.1

6015. INVESTIGATION OF THE COMPOSITION OF PRIMARY COSMIC RAYS.
S.N.Vernov, V.L.Ginzburg, L.V.Kurnosova, L.A.Razorenov and M.I.Fradkin.
Uspekhi fiz. Nauk, Vol. 63, No. 1a-1b, 131-48 (1957). In Russian.

Review article largely concerned with the value of an artificial earth satellite as a means to taking observations on the energy spectrum of high-energy particles. A table summarizing current information on the α-particle stream in primary cosmic radiation is given. 48 references. C.R.S.Manders

537.591.1

6016. A STUDY OF SLOW μ-MESONS IN THE STRATOSPHERE BY THE METHOD OF DELAYED COINCIDENCES. V.F.Tulinov.
Zh. éksper. teor. Fiz., Vol. 33, No. 5(11), 1163-5 (1957). In Russian.

A study was made of the altitude dependence of μ-mesons of energy ~100 MeV at altitudes of up to 25 km at 51° and 31° N latitude. The spectra of meson generation in the atmosphere were found. A.

537.591.1

6017. ELECTRON SPECTRUM AT 3200 m ABOVE SEA-LEVEL.
M.I.Dalon.
Zh. éksper. teor. Fiz., Vol. 33, No. 5(11), 1166-74 (1957).
In Russian.

Using a magnetic spectrometer coupled with a multi-plate cloud chamber, a momentum spectrum was obtained of cosmic-radiation electrons in the momentum interval from 4×10^8 to 4×10^9 eV/c. The problem of the penetrability of fast electrons ($E \geq 4 \times 10^8$ eV) is considered. A.

537.591.15

6018. INTERACTION OF PARTICLES OF 10^{12}-10^{13} eV ENERGY WITH LIGHT NUCLEI. N.L.Grigorov, V.Ya.Shestoperov, V.A.Sobinyakov and A.V.Podgurskaya.
Zh. éksper. teor. Fiz., Vol. 33, No. 5(11), 1099-109 (1957).
In Russian.

A study was made of the spectrum of large ionization bursts in 44 ionization chambers covered with a layer of lead of 10 and 12 cm thickness at an altitude of 3200 m above sea level. From the probability of observation of bursts accompanied by air showers, conclusions are drawn on the range of particles of $\sim 10^{12}$ eV for interaction in air. There were cases of the simultaneous appearance of two and more bursts of commensurable magnitude in several chambers separated from each other (bursts with spatial structure). A.

537.591.15

6019. THE ANGULAR DISTRIBUTION OF THE AXES OF EXTENSIVE AIR SHOWERS AT SEA LEVEL.
A.T.Abrosimov, V.I.Goman'kov, I.A.Ivanovskaya and L.I.Saryčheva.
Zh. éksper. teor. Fiz., Vol. 33, No. 5(11), 1110-15 (1957). In Russian.

A cloud-chamber study was made of the angular distribution of the axes of extensive air showers at sea level. In approximating the angular distribution by the $\cos^n \theta$ type relation, the exponent was found to be $n = 8.3 \pm 1.4$. A.

537.591.5

6020. OCCURRENCE OF SOFT RADIATION DURING THE MAGNETIC STORM OF 29 AUGUST 1957.. K.A.Anderson.
J. geophys. Res., Vol. 62, No. 4, 641-4 (Dec., 1957).

The time sequence of events as recorded at Fort Churchill, Canada, before and during the intense magnetic storm are outlined. Cosmic-ray measurements made in a balloon indicated a rapid increase in amplitude about 20 min before the time of commencement of the storm, and it is suggested that this extra-radiation at high altitude may be X-rays of energy < 700 keV, produced by the acceleration of electrons within a few earth radii of the earth's surface. G.M.Brown

537.591.5

6021. SOME RESULTS ON THE TIME VARIATION OF THE HEAVY COMPONENT OF PRIMARY COSMIC RAYS.
N.C.Barford, C.Davis, C.Castagnoli, C.Franzinetti and A.Manfredini.
Ricerca sci., Vol. 26, No. 10, 3061-6 (Oct., 1956).

An experiment is described, which was planned to measure the flux of heavy, primary cosmic-rays and to investigate its time variation. The experiment was carried out by exposing nuclear emulsions at high altitudes by means of balloons. The value of the flux obtained is in agreement with that of other experiments at the same latitude. The results give no evidence for any change in flux during the course of the exposure. A.

537.591.

6022. ALTITUDE-VARIATION OF COSMIC RAY STARS.
K.Shimizu.
Sci. Rep. Tôhoku Univ. First Ser., Vol. 40, No. 4, 224-32 (Jan., 195?

The star frequency of cosmic rays was measured using nuclear emulsions exposed at several altitudes between sea level and 3776 m and its altitude-variation is obtained. Star-size distributions were also considered, the contributions from the light and heavy nuclei contained in the emulsion being studied, and the mean propagation of α-particles appearing in the stars measured. A

537.591.5

6023. VARIATIONS IN COSMIC RAYS.
L.I.Dorman and E.L.Feinberg.
Uspekhi fiz. Nauk, Vol. 59, No. 2, 189-228 (1956). In Russian.

Current experimental information is summarized excellently in tabular form, showing, for latitudes 0° and 50° N, the variations of hard component, neutron content, ionizing component etc., under the following conditions: seasonal, daily, semi-diurnal, yearly, 11-yearly, 27-day, magnetic storm, major and minor solar protuberance, etc. Also discussed are such problems as the correlation of variations with various astrophysical phenomena, and the origin of cosmic rays. 55 references. C.R.S.Manders

537.591.8 : 539.12

6024. A CASE OF DOUBLE PAIR PRODUCTION BY AN ELECTRON. C.Castagnoli and A.Manfredini.
Nuovo Cimento, Vol. 8, No. 5, 778-80 (June 1, 1958).

An event found in nuclear emulsions exposed to cosmic radiation at 25 km altitude. S.J.Goldsack

537.591.8 : 539.12

GENERATION OF SLOW π-MESONS BY COSMIC RAY PARTICLES. See Abstr. 5234

MAGNETISM

538.082.74

6025. QUARTZ HELIX MAGNETIC SUSCEPTIBILITY BALANCE USING THE CURIE–CHENEVEAU PRINCIPLE.
F.E.Senftle, M.D.Lee, A.A.Monkewicz, J.W.Mayo and T.Pankey.
Rev. sci. Instrum., Vol. 29, No. 5, 429-32 (May, 1958).

A quartz spring-balance is described which can be used to measure the magnetic susceptibility of submilligram amounts of sample. The magnetic field is supplied by a moving permanent magnet, and the susceptibility is determined by the deflection of the spring which is observed in a measuring microscope. The apparatus is calibrated by a comparison standard (platinum) and results are shown for platinum, nickel aluminate, lead, manganese and sucrose. A precision of better than 2% can be obtained on submilligram amounts of paramagnetic substances having a magnetic susceptibility of from 1 to 50×10^{-6} e.m.u./g. On weakly paramagnetic or diamagnetic substances comparable precision can be obtained on less than 10 mg amounts of sample. A.

538.11 : 523.877

MOTION OF CHARGED PARTICLES IN A FORCE-FREE MAGNETIC FIELD. See Abstr. 5592

538.113

6026. COULOMB INTERACTIONS AND THE DIAMAGNETISM OF FREE ELECTRONS. II. H.Kanazawa.
Progr. theor. Phys., Vol. 17, No. 1, 1-5 (Jan., 1957).

For Pt I, see Abstr. 8890 (1956). The effect of the term $\Delta j(x)$, which should be added to the current density operator $j(x)$, on the Landau diamagnetism is investigated. It is shown that the magnitude of the diamagnetic susceptibility slightly increases due to the long-range part of the Coulomb interactions between electrons. A.

538.114

6027. MAGNETIZATION MECHANISM AND DOMAIN STRUCTURE OF MULTIDOMAIN PARTICLES. H.Amar.
Phys. Rev., Vol. 111, No. 1, 149-53 (July 1, 1958).

The free energy of a two-domain cube of iron is considered with and without an applied magnetic field. It is shown that the two-domain configuration may exist only beyond a certain critical size (200 A), that the wall characteristics are size dependent and that their values are substantially different from the values assumed in bulk material. Moreover, magnetization by wall motion is shown to be a "hard process". A.

538.114 : 539.2 : 548.74

6028. CRITICAL MAGNETIC SCATTERING OF NEUTRONS BY IRON. R.D.Lowde.
Rev. mod. Phys., Vol. 30, No. 1, 69-74 (Jan., 1958).

In the vicinity of a phase transformation an effect occurs in the magnetic scattering of neutrons (critical scattering) which results in the production of additional background. Theory and experiment are compared over a region at and near the 110 reflection in the Laue neutron diffraction pattern of an iron crystal, the "critical" part of the observed background being separated from normal background and from phonon scattering and its space and temperature dependence studied. Predictions from the Heisenberg theory of ferromagnetism are found to be verified near the Laue position but not elsewhere (possibly due to the breakdown of the quasielastic approximation used in the calculations). It is concluded that the localized-electron type of theory accounts for the observed phenomena within the limitations of the available scattering formulae.
J.Thewlis

538.114 : 539.2 : 548.74

6029. THEORY OF CRITICAL SCATTERING.
R.J.Elliott and W.Marshall.
Rev. mod. Phys. Vol. 30, No. 1,75-89 (Jan., 1958).

The critical scattering of neutrons in ferromagnets near the Curie temperature is investigated in detail using the standard theories of order–disorder. The method is an improvement and extension of the calculation by Zernike (Physica, Vol. 7, 565, 1940) of the propagation of correlations in alloys near T_c. The approximation is also reasonably satisfactory at high temperature but fails at low temperatures.
S.F.Edwards

538.114 : 539.2 : 548.74

6030. THEORY OF THE MAGNETIC SCATTERING OF NEUTRONS BY CoO. T.Nagamiya and K.Motizuki.
Rev. mod. Phys., Vol. 30, No. 1, 89-93 (Jan., 1958).

The experimental results for the magnetic scattering of neutrons by CoO are compared with those predicted by the theory of Kanamori (Prog. Theor. Phys., 17, 177, 197 (1957). Good agreement is obtained if suitable (permissible) modifications are made to the theory, no radical change being necessary however.
J.Thewlis

538.122 : 538.245

6031. AN EXPERIMENTAL STUDY OF THE TOPOGRAPHY OF THE MAGNETIC FIELD DUE TO ARTIFICIALLY PRODUCED SURFACE DEFECTS IN FERROMAGNETIC MATERIALS. N.N.Zatsepin.
Zh. tekh. Fiz., Vol. 27, No. 2, 368-73 (1957). In Russian.

In designing devices for magnetic detection of microscopic cracks in metals, detailed knowledge of the topography of the magnetic field in the immediate vicinity of such flaws is required. Since accurate data cannot be obtained analytically, while the naturally occurring flaws are not suitable for experimental study owing to their small dimensions, this problem was approached by using test pieces of unalloyed 0.3% C steel 6 × 1.2 × 1.2 cm large, each of which had a "defect" in the form of a square groove cut in the centre of the 6 × 1.2 face across the whole width of the bar. The grooves were 0.3, 0.6 and 3.0 mm wide, their depth varying between 2 and 52 mm. A detailed description of the experimental technique is given and the results are presented in the form of numerous graphs showing how the normal and tangential components of the magnetic field vary in space, and how they are affected by the variation of the external field and the degree of magnetization of the test piece.
M.H.Sloboda

538.122.08 : 537.533 : 621.384.6 : 621.317.42

6032. MEASUREMENT OF THE FIELD OF MAGNETS OF ACCELERATORS WITH STRONG FOCUSING.
N.N.Grekov, A.P.Ryabov and L.L.Gol'din.
Priborȳ i tekh. Éksper., 1956, No. 2, 29-37. In Russian.

A method of measurement of a time-varying magnetic field with an almost constant gradient is described. Special coils, which enable the gradient of the magnetic field at the centre of the coil to be measured directly, and an integrator with a stabilized zero, were used. The results were read from an oscillograph. The method measured the magnetic field configuration to an accuracy of 0.02%. The high sensitivity of the apparatus made possible the study of a number of weak effects, for example, measurement of the field configuration when thin non-magnetic sheets were introduced into the gap.
P.Collins

538.22

6033. THE ADIABATIC FAST PASSAGE EXPERIMENT IN MAGNETIC RESONANCE. J.G.Powles.
Proc. Phys. Soc., Vol. 71, Pt 3, 497-500 (March, 1958).

A simple physical explanation of the reversal of the macroscopic magnetization in a nuclear or electronic system after passage through resonance is given.
J.E.Caffyn

538.221

6034. FERROMAGNETIC RESONANCE IN POLYCRYSTALLINE FERRITES. J.Snieder.
Appl. sci. Res. B, Vol. 7, No. 3, 185-32 (1958).

An experimental and theoretical study is made of the propagation of TE_{11}-waves of wavelength 3.2 cm in a round waveguide containing a concentric round rod of Ferroxcube IV (NiZn ferrite) magnetized by a static magnetic field in a longitudinal direction. The Faraday rotation and the ellipticity when the wave has passed a given length of rod is determined as a function of the static field strength through resonance and of the temperature over a range from −30 to 100°C. On the basis of the theory of ferromagnetic resonance with damping the elements of the gyromagnetic permeability tensor are computed. Using them the rotation angle and ellipticity can be expressed in terms of the angular frequency of the wave, the radius of the waveguide, the radius and length of the rod, the static field strength, the static magnetization, the gyromagnetic ratio and the damping constant. The gyromagnetic ratio is determined from resonance measurements on spheres of Ferroxcube while the damping constant is chosen so as to give the best agreement between theory and experiment. An interpretation of the values of the gyromagnetic ratio and of the resonance width in terms of the porosity of the ferrites is given. The behaviour of the damping constant as a function of porosity is briefly discussed.
A.

538.221 : 537.311.62

SKIN EFFECT AND FERROMAGNETIC RESONANCE. See Abstr. 5909

538.221

6035. NEW TECHNIQUES FOR THE STUDY OF BITTER FIGURES.
D.J.Craik and P.M.Griffiths.
Brit. J. appl. Phys., Vol. 9, No. 7, 279-82, 276-7 (July, 1958).

Techniques employing optical and electron microscopy are described. In the case of the optical microscope an improved resolution and clarity is achieved. The method for the electron microscope is a modification of that previously published (Abstr. 7531/1956). Examples of the use of the methods are given.
A.

538.221

6036. DOMAIN WALL ORIENTATIONS IN SILICON–IRON CRYSTALS. C.D.Graham,Jr and P.W.Neurath.
J. appl. Phys., Vol. 28, No. 8, 888-91 (Aug., 1957).

The stable orientation of a 180° ferromagnetic domain wall in a cubic crystal with <100> easy directions is calculated as a function of crystal orientation for a sheet specimen with a <100> direction parallel to the surface. The effect of the second crystal anisotropy constant K_2 on the domain wall energy is considered and shown to be negligible if $|K_2| < K_1$. If the crystal surface is a {110} plane, there are two equivalent stable domain wall positions, with the wall making an angle of ±32° with the normal to the specimen surface. If the crystal surface is a {100} plane, the domain wall lies normal to the surface. These results are changed if a stress is applied to the sample. Experimentally determined domain wall orientations agree with the calculated positions.
A.

538.221 : 548.736.4

6037. CRYSTALLOGRAPHIC AND MAGNETOCHEMICAL STUDIES ON ABO_3 GROUP COMPOUNDS OF LANTHANON AND MANGANESE OXIDES. R.C.Vickery and A.Klann.
J. chem. Phys., Vol. 27, No. 5, 1161-3 (Nov., 1957).

Perovskite-structured compounds were prepared containing manganese oxide with praseodymium, neodymium, and dysprosium oxides. X-ray crystallographic data were obtained for these compounds, and unit cell edge values of 3.82, 3.80, and 3.70 A are found for $PrMnO_3$, $NdMnO_3$, and $DyMnO_3$, respectively. Magnetic susceptibilities of these compounds were measured down to liquid-air temperatures and gram susceptibilities found to range from 40-158% above those indicated by additive values for the component oxides, highest increments being found in praseodymium systems. Susceptibility curves follow the Curie–Weiss law without deviation, and Weiss constants of 115, 112, and 62 were found for the praseodymium, neodymium, and dysprosium compounds, respectively.
A.

538.221

6038. MAGNETIC ANALYSIS OF ALLOYS BY ELECTRON DIFFRACTION. S.Yamaguchi.
J. chem. Phys., Vol. 27, No. 6, 1310-11 (Dec., 1957).

Electron diffraction patterns obtained from ferromagnetic

substances (Cu–Ni and stainless steel) are influenced by the magnetic fields of the substances. The results obtained are of use for magnetochemical analysis of ferromagnetic alloys. A.

538.221

6039. ON THE MAGNETIC PROPERTIES OF CHROMIUM SULFIDES. M.Yuzuri, T.Hirone, H.Watanabe, S.Nagasaki and S.Maeda.
J. Phys. Soc. Japan, Vol. 12, No. 4, 385-9 (April, 1957).

The thermomagnetic properties of chromium sulphide $CrS_{1.17}$ were studied. The spontaneous magnetization of this compound, which is probably of the ferrimagnetic origin, suddenly disappears during cooling at −120° C. A slight heat absorption was observed at this transition point. By X-ray analysis excess diffraction lines, besides those of the ideal crystal lattice of the nickel arsenide type, were observed at room temperature, which shows a superlattice structure with parameters of 2 c and $2\sqrt{3}$ a, c and a being those of the original lattice. It was also found by X-ray analysis that there was no change of the crystal lattice at the magnetic transition temperature, −120° C. This compound showed a ferrimagnetic behaviour with the asymptotic Curie temperature at 150° K. A peak in the susceptibility v. temperature curve was found by thermomagnetic measurements in the temperature range from liquid helium temperature to −120° C. The nature of transition is briefly discussed. A.

538.221

6040. MAGNETIC ANNEALING EFFECT IN COBALT-SUBSTITUTED MAGNETITE SINGLE CRYSTALS.
R.F.Penoyer and L.R.Bickford,Jr.
Phys. Rev., Vol. 108, No. 2, 271-7 (Oct. 15, 1957).

The effect of magnetic annealing at 375° K on the room-temperature anisotropy of a series of six single crystals in the composition series $Co_xFe_{3-x}O_4$, in the range of x values between 0.0 and 0.15, is investigated. The anneal-induced anisotropy is shown to be represented by the equation $W_U = -F\Sigma_i\alpha_i^2\beta_i^2 - G\Sigma_{i>j}\alpha_i\alpha_j\beta_i\beta_j$, where α_i and β_i are direction cosines of the magnetization during measurement and during the annealing process, respectively. F and G are shown to vary with x in a regular fashion: $F \cong 10.1 \times 10^6 x^2$ erg/cm^3 and $G \cong 9.25 \times 10^6 x$ erg/cm^3. These results cannot be explained by the Néel orientation-ordering model or by the precipitate model of magnetic annealing. A new model, involving cobalt ions individually rather than in pairs or larger agglomerates, is introduced. A.

538.221

6041. NEUTRON DIFFRACTION STUDY OF THE MAGNETIC PROPERTIES OF $MnBr_2$.
E.O.Wollan, W.C.Koehler and M.K.Wilkinson.
Phys. Rev., Vol. 110, No. 3, 638-46 (May 1, 1958).

The antiferromagnetic structure of $MnBr_2$ (T_N = 2.16°K) was determined by single-crystal neutron diffraction measurements at temperatures down to 1.35°K and with magnetic fields (0-13 kilo-oersteds) applied to the sample. The antiferromagnetic structure appeared to have hexagonal symmetry in the absence of a magnetic field but this was found to be associated with a structure domain-growth property. The true magnetic structure was found to be associated with one or another of three hexagonal axes, the particular growth direction being determined by the direction of an applied magnetic field. Information relating to indirect magnetic exchange via the bromine ions in this crystal was obtained from a study of the domain growth properties. The antiferromagnetic ordering transition in this compound was found to be nearly first order rather than of the usual second order type. A small lowering (~ 2%) of T_N was observed for an applied field of 13.1 kilo-oersteds. Short-range order data were obtained from powder patterns. A.

538.221

6042. MAGNETIC PROPERTIES OF THE Gd–La AND Gd–Y ALLOYS. W.C.Thoburn, S.Legvold and F.H.Spedding.
Phys. Rev., Vol. 110, No. 6, 1298-301 (June 15, 1958).

For alloys of high Gd content, paramagnetic to ferromagnetic transitions are observed with decreasing temperature. As the Gd content is decreased, ferromagnetic ordering is replaced by antiferromagnetic ordering. In the Gd–La alloys, a crystal structure change affects the magnetic properties. A.

538.221

6043. MAGNETIZATION IN SINGLE CRYSTALS OF SOME RARE-EARTH ORTHOFERRITES.
R.M.Bozorth, V.Kramer and J.P.Remeika.
Phys. Rev. Letters, Vol. 1, No. 1, 3-4 (July 1, 1958).

Describes results of measurements between 1.3°K and room temperature for different directions in crystals of $MFeO_3$ (M = Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb and Lu); the results are discussed in terms of the orbital moment and the crystalline anisotropy due to spin–orbit coupling. For some of the ferrites the moment becomes large (up to 3 μ_B) at low temperatures, and thus ceases to be "parasitic". E.P.Wohlfarth

538.221

6044. AN ANOMALOUS MAGNETIC TRANSITION IN ANHYDROUS COPPER SULPHATE.
A.S.Borovik-Romanov and N.M.Kreĭnes.
Zh. éksper. teor.Fiz.,Vol. 33, No. 5(11), 1119-22 (1957). In Russian.

The magnetic properties of fine-grained anhydrous $CuSO_4$ in the region 1.5-300° K were investigated. Below T_C = 34.4° K, the substance has antiferromagnetic properties. The transition to the antiferromagnetic state is accompanied by an anomalous twofold growth in susceptibility in the temperature interval ~1.5° K. A.

538.221

6045. ON THE MAGNETIC STRUCTURE OF TRANSITION METAL FLUORIDES. I.E.Dzyaloshinskiĭ.
Zh. éksper. teor. Fiz., Vol. 33, No. 6(12), 1454-6 (1957). In Russian.

The method described earlier (Abstr. 3224/1958) is employed to investigate the magnetic structure of antiferromagnetic crystals of MnF_2, CoF_2, FeF_2 and NiF_2. It is shown that crystals with such symmetry may possess weak ferromagnetism. A.

538.221 : 536.7

THERMODYNAMICS AND MAGNETIC STRUCTURES OF THE ALLOTROPIC MODIFICATIONS OF MANGANESE. See Abstr. 5853

538.221 : 537.311.31

6046. THIN FERROMAGNETIC FILMS. ELECTRICAL PROPERTIES OF THIN NICKEL FILMS.
G.Goureaux and A.Colombani.
C.R. Acad. Sci. (Paris), Vol. 246, No. 5, 741-4 (Feb. 3, 1958). In French.

Reports conductivity measurements on films with thicknesses varying from 20 to 1100 A in the temperature range from 0° to 420°C. Graphs of resistivity against temperature for various thicknesses show that both the paramagnetic and ferromagnetic Curie temperatures decrease with decreasing thickness, while their difference increases. D.M.Edwards

538.221

6047. THIN FERROMAGNETIC FILMS. MAGNETIC PROPERTIES DEDUCED FROM THE CONDUCTIVITY OF THIN NICKEL FILMS. A.Colombani and G.Goureaux.
C.R. Acad. Sci. (Paris), Vol. 246, No. 13, 1979-83 (March 31, 1958). In French.

Results previously reported (see preceding abstract) on the variation of the ferromagnetic Curie point with film thickness are discussed on the basis of theoretical work by Klein and Smith (Abstr. 4528/1951). D.M.Edwards

538.221

6048. FERRIMAGNETIC FLUORIDE — $Na_5Fe_3F_{14}$.
K.Knox and S.Geller.
Phys. Rev., Vol. 110, No. 3, 771-2 (May 1, 1958).

A preliminary announcement of relatively strong ferrimagnetism with a Curie point about 80° K, and a discussion of the possible crystal structure. E.P.Wohlfarth

538.221 : 539.2

6049. ANTIFERROMAGNETIC ORDERING AND ELECTRONIC STRUCTURE OF $CuCl_2.2H_2O$ AS DETERMINED FROM NUCLEAR MAGNETIC RESONANCE. R.E.Rundle.
J. Amer. Chem. Soc., Vol. 79, No. 13, 3372-4 (July 5, 1957).

The nuclear magnetic resonance study of $CuCl_2.2H_2O$ by Poulis and Hardeman (Abstr. 5899/1952, 2910/1954) is coupled with neutron diffraction data on proton positions to obtain the type of antiferromagnetic ordering in $CuCl_2.2H_2O$, and the distribution of the odd-electron in the $CuCl_2.2H_2O$ "molecule". It is found that the odd-electron must be about 25% on each chlorine, 50% on copper. This distribution is consistent with a molecular orbital treatment of the complex, but not with crystal field theory or with Pauling's theory of directed valence in square copper complexes. The use of nuclear magnetic resonance in crystals as a probe for determining the distribution of magnetic electrons appears to be sensitive and deserving of further use. A.

538.221 : 539.2

MAGNETIC PROPERTIES AND ELECTRONIC STRUCTURE OF Ni AND ITS ALLOYS. See Abstr. 4410

538.222

6050. ON THE MAGNETIC BEHAVIOUR OF FERROUS FLUOSILICATE. D.Palumbo.
Nuovo Cimento, Vol. 8, No. 2, 271-81 (April 16, 1958).

A theoretical interpretation of some new results of Jackson on the temperature dependence of the susceptibility of $FeSiF_6 \cdot 6H_2O$, parallel and perpendicular to the crystal axis, over the range 1.57°K to room temperature. The lower energy levels of the Fe^{++} ion are studied when a trigonal component T is included in the crystal field. Spin-Hamiltonians are defined for the cases when T is: (a) much stronger than the spin–orbit interaction and (b) of the same order. In both cases the calculated susceptibility is in qualitative agreement with experiment but good quantitative agreement is obtained only in case (a). One of the three parameters involved is introduced to take approximate account of the effect of covalent bonds.

D.M.Edwards

538.222

6051. THE SHAPE OF PARAMAGNETIC ELECTRON RESONANCE CURVES IN VERY WEAK FIELDS. R.Beeler.
Arch. Sci. (Geneva), Vol. 10, No. 2, 185-221 (April-June, 1957). In French.

Paramagnetic electron resonance was studied in solutions of sodium in ammonia in two types of experiment: (a) beats were observed using a resonance field of 8.2 G (23 Mc/s) with 2 kc/s modulation of amplitude 1.1 G; (b) a Bloch-type induction experiment was used to obtain curves comprising a measured mixture of the absorption and dispersion components of the susceptibility, perpendicular to the applied h.f. field, at frequencies in the range from 61 to 244.5 kc/s (21.8-88 mG). The amplitude of the h.f. magnetic field ranged up to 4.15 times the static resonance field. A single relaxation time $\tau = 2.34 \times 10^{-6}$ sec was obtained from measurements at 244.5 kc/s (88 mG). Small values of $\omega\tau$ from 3.6 to 0.9 enabled a study of the effect of saturation to be made. The equations of Garstens and Kaplan (Abstr. 9015/1955) were used to prepare theoretical curves corresponding to the experimental conditions, which showed satisfactory agreement with the experimental results. A review of the theoretical background to the experiments is given.

A.J.Manuel

538.222

6052. A MICROWAVE ELECTRON SPIN RESONANCE SPECTROMETER. M.B.Palma-Vittorelli and M.U.Palma.
Nuovo Cimento Suppl., Vol. 7, No. 1, 139-54 (1958).

A sensitive microwave electron spin resonance spectrometer is described which gives, at room temperature, a signal-to-noise ratio of 4/1 with about 10^{13} ΔH magnetic centres (where ΔH is the line width). The magnetic field homogeneity is 3×10^{-4}% over the sample volume and 10^{-2}% over the whole cavity; it is stabilized to 2×10^{-3}% short-term, and 5×10^{-3}% long-term. The klystron frequency is stabilized to 10^{-4}%. A detailed description of the circuits and experimental arrangement is given.

J.M.Baker

538.222 : 539.1.07

6053. AUTOMATIC FREQUENCY CONTROL FOR MARGINAL-OSCILLATOR MAGNETIC ABSORPTION SPECTROMETER. A.W.Nolle and H.L.Henneke.
Rev. sci. Instrum., Vol. 28, No. 11, 930-2 (Nov., 1957).

A closed-loop frequency-control circuit is added to an r.f. spectrometer of the Pound–Knight–Watkins type. Frequency variations are detected by a discriminator circuit operating at a heterodyne frequency of 175 kc/s. Correction signals affect a saturable reactor which is added to the spectrometer. Frequency variations are reduced by factors of 5 to 11. Larger factors can be obtained without instability. The objects are (a) to reduce frequency drift due to physical changes of the coil surrounding the sample; (b) to reduce distortion of absorption line shape, due to frequency modulation arising from the dispersion component in magnetic resonance.

A.

538.224

6054. A NEW METHOD OF INTERPRETING THE MAGNETIC SUSCEPTIBILITIES OF DIAMAGNETIC ORGANIC COMPOUNDS. Ya.G.Dorfman.
Dokl. Akad. Nauk SSSR, Vol. 119, No. 2, 305-6 (1958). In Russian.

The susceptibility is usually considered as a sum of classical diamagnetism and Van Vleck paramagnetism. This is refined by allowing for intermolecular paramagnetism and the diamagnetism of individual atoms. The resulting four-term formula compares favourably with experiment and the empirical formula of Pascal.

S.F.Edwards

538.23

6055. "CREEPING" (REPTATION) OF ASYMMETRICAL HYSTERESIS LOOPS AS A FUNCTION OF THE NUMBER OF CYCLES DESCRIBED. N.Van Dang.
C.R. Acad. Sci. (Paris), Vol. 246, No. 16, 2357-9 (April 21, 1958). In French.

If a ferromagnetic specimen is exposed repeatedly to a succession of fields H_A and H_B, the magnetizations produced after the n-th cycle J_{An}, J_{Bn} vary with n. Experiments show that the creeping terms $J_{An} - J_{A1}$ are proportional to $(\log n)^{1/2}$ for $n > 20$ in agreement with the theory of Néel assuming a random internal field coupling the elementary domains.

D.J.Oliver

538.23

6056. "CREEPING" (REPTATION) OF ASYMMETRICAL HYSTERESIS LOOPS AS A FUNCTION OF THE ASYMMETRY AMPLITUDE. N.Van Dang.
C.R. Acad. Sci. (Paris), Vol. 246, No. 21, 3034-7 (May 28, 1958). In French.

A continuation of previous work (see preceding abstract). The effect is measured between zero field and a field h, and for a given order has a maximum when h is of the order of the coercive force.

E.P.Wohlfarth

538.23 : 539.231

6057. COERCIVE FORCE vs. THICKNESS FOR THIN FILMS OF NICKEL–IRON. C.O.Tiller and G.W.Clark.
Phys. Rev., Vol. 110, No. 2, 583-5 (April 15, 1958).

Films of composition 82%Ni:18%Fe and thickness between 2000 and 3000 A were evaporated on to a glass substrate in an orienting field. A series of thinner films were prepared by successive etching processes and the coercive force measured, the thickness at each stage being obtained by interferometry. The coercivity was found to be inversely proportional to the thickness contradicting the Néel theory.

D.J.Oliver

538.244.2

6058. PRODUCTION AND USE OF HIGH TRANSIENT MAGNETIC FIELDS. II. H.P.Furth, M.A.Levine and R.W.Waniek.
Rev. sci. Instrum., Vol. 28, No. 11, 949-58 (Nov., 1957).

For Pt I, see Abstr. 6789 (1956). The transient containment of high magnetic energy densities in coils of various geometries is discussed. Inherent mechanical and thermal limitations are shown to apply to coils relying solely on the strength of materials. The usefulness of inertial effects is demonstrated. Instrumentation is described for producing 10 μsec range pulses of amplitude up to 1.6 MG in single-turn coils. Experimental observations record the appearance of "saw effect" and Kruskal–Schwarzschild instabilities at very high fields. The limitations characteristic of conventional coils can be overcome in force-free geometries. The appropriate mathematics is developed and illustrated with practical examples.

A.

538.245

6059. MINIMUM SATURATING FIELDS FOR FERROMAGNETIC CRYSTALS. J.S.Kouvel.
J. appl. Phys., Vol. 28, No. 6, 704-6 (June, 1957).

The conditions for magnetic saturation are investigated analytically for a very thin ferromagnetic single-crystal disk or spheroid of cubic crystalline symmetry and positive magnetic anisotropy constant K_1, whose axis of revolution is perpendicular to a {100} or {110} plane. Contrary to some previous work, it is found that an external field ranging in magnitude from NI_S to $NI_S + 2K_1/I_S$ (where NI_S is the demagnetizing field) is sufficient for saturation in any direction in either of these planes. Above this field, the crystal behaves as a single magnetic domain. The applicability of the calculated minimum saturating fields to torque measurements is discussed.

A.

538.245

6060. THE INITIAL MAGNETIZATION OF ALPHA-IRON AT HIGH TEMPERATURES. L.Alberts and B.J.Shepstone.
Phil. Mag. (Eighth Ser.), Vol. 3, 700-6 (July, 1958).

As the inherent crystal anisotropy of iron tends to zero above 600°C the initial magnetization above this temperature is considered in terms of purely rotational movements of the domain vectors from preferential directions determined by applied and internal stresses. Experimental results on the influence of applied stress on the initial permeability are described. It is shown that the results are in fair agreement with the theoretical predictions.

A.

538.27 : 538.652

6061. MAGNETOSTRICTION OF ALUMINUM–IRON SINGLE CRYSTALS IN THE REGION OF 6 TO 30 ATOMIC PERCENT ALUMINUM. R.C.Hall.
J. appl. Phys., Vol. 28, No. 6, 707-13 (June, 1957).

The spontaneous saturation magnetostriction and the forced magnetostriction were measured on slowly cooled single crystals of the ferromagnetic aluminium–iron alloys in the composition range from 6 to 30 atomic % aluminium. The value of the first constant of spontaneous saturation magnetostriction at 6 atomic % aluminium is similar to that at 6 atomic % silicon in iron. At compositions containing larger amounts of aluminium, the first constant becomes very large; however, near 30% aluminium the constant drops and approaches zero. The second constant of spontaneous saturation magnetostriction is negative below 17% aluminium, reaches a maximum near Fe_3Al, and drops near 30% aluminium. Values of the isotropic forced-magnetostriction constant below 25 atomic % aluminium were found to be slightly higher than that for iron but less than that for silicon iron. Above 25% aluminium the isotropic constant became very large. The anisotropic forced-magnetostriction constants were the largest for the single crystal having 29.6% aluminium; a good fit of the experimental data to be calculated curve was found for this alloy. A.

ELECTROMAGNETISM. ELECTRODYNAMICS

538.3

6062. THE UNDETERMINED CONSTANT IN RELATIVE-VELOCITY ELECTRODYNAMICS.
R.D.Driver; P.Moon and D.E.Spencer.
J. Franklin Inst., Vol. 261, No. 5, 547-9, 550-1 (May, 1956).

It is pointed out that equation 17 in Moon and Spencer's treatment of the Ampère force (Abstr. 2253/1956) is incorrect, so that the undetermined constant C appearing in the equation for the force between moving charges drops out of the calculation. The consequences of assuming constant electron mass are discussed. A general force equation for low velocities and accelerations, assuming Galilean relativity is put forward. Driver's assumptions and formulae are criticized by Moon and Spencer in a reported discussion. M.J.Kearsley

538.3 : 530.12

6063. ON THE GEOMETRIZATION OF THE ELECTROMAGNETIC FIELD. J.I.Horváth.
Nuovo Cimento, Vol. 7, No. 5, 636-48 (March 1, 1958). In German.

By means of a generalization of the Levi-Civita parallel transfer, it is shown that there is a possibility of giving a purely geometrical interpretation of the existence of the electromagnetic field in a given gravitational field in the four-dimensional Riemann space. The consequences of the theory are discussed in detail and it is further shown that the geometrization of the electromagnetic field does not influence the known and verified results of general relativity.
M.J.Kearsley

538.3 : 621.3.013

6064. ELECTROMAGNETIC ENERGY TRANSFER.
P.Hammond.
Proc. Instn Elect. Engrs, Monogr. 286, publ. Feb., 1958 (Vol. 105C, 352-9).

Republication of the monograph abstracted in Abstr. 659 (1958).

538.3

6065. EQUIVALENCE THEOREMS FOR ELECTROMAGNETIC FIELDS. G.C.Corazza.
Ricerca sci., Vol. 27, No. 7, 2109-19 (July, 1957). In Italian.

A number of theorems of considerable interest are grouped together, and treated systematically using the concepts of electric and magnetic surface currents. In order to give a clear idea of the meaning of impressed currents, a possible formulation of the theory of electromagnetic fields is illustrated. Two of the theorems considered (analogues of the theorems of Thevenin and Norton in the circuit theory) show new properties of the electromagnetic fields. A.

538.31

6066. REACTION OF LABORATORY MAGNETIC FIELDS AGAINST THEIR CURRENT COILS. E.N.Parker.
Phys. Rev., Vol. 109, No. 5, 1440 (March 1, 1958).

It is shown, using the virial theorem, that the forces exerted on a current-carrying wire by the magnetic field of the current in the wire are always of the same order as the stresses carried by the magnetic field. Thus it is not possible, by suitable configuration of the current-carrying wires, to construct a magnetic system wherein the currents are free of magnetic stresses, even for the so-called "force-free" fields. A.

538.3 : 532.

6067. AN EXPERIMENT ON AXISYMMETRIC FLOW OF LIQUID SODIUM IN A MAGNETIC FIELD. B.Lehnert.
Ark. Fys., Vol. 13, Paper 10, 109-16 (1957).

An axisymmetric motion was generated by a rotating disk in a cylindrical vessel containing 58 litres of liquid sodium and placed in an external magnetic field. Measurements of the internally induced magnetic fields indicate the existence of a toroidal component which circulates around the axis of symmetry and a poloidal component which is restricted to planes through the same axis. The results agree with the elementary theory, as far as orders of magnitude are concerned. There has been observed neither a formation of instabilities in the twisted field, nor an operation as a self-exciting dynam the velocities in the experiment are too small and the degree of asymmetry too low to produce such phenomena. A.

538.3 : 532.5

6068. THE DISPERSION OF A CURRENT ON THE SURFACE OF A HIGHLY CONDUCTING FLUID. K.Stewartson.
Proc. Cambridge Phil. Soc., Vol. 53, Pt 3, 774-5 (July, 1957).

Surface currents corresponding to discontinuities in the tangential components of a magnetic field are allowable at the boundary of a perfectly conducting solid and, simularly, current sheets are allowed on the free boundary of a perfectly conducting fluid. If the normal component is non-zero such a discontinuity in H would be dispersed instantaneously and the tangential components must be continuous at the surface. C.A.Hogarth

538.3 : 532.5

6069. THE TRANSMISSION OF STRONG SHOCK WAVES THROUG MAGNETIC FIELDS. K.Dolder.
Atomic Energy Res. Establ. (Harwell), Mem. GP/M 199, 7 pp. (1957)

Existing theoretical and experimental investigations of the passage of shock waves through magnetic fields are reviewed. Two procedures by which the strength of hydromagnetic interaction can be estimated are then described. In the first method equations governing hydromagnetic flow are set down and dimensionless parameters, which determine the strength of this interaction, are obtained. Values of these parameters are calculated for conditions likely to be encountered in shock tubes. The second method is based upon more detailed calculations given by Lin, and affords not only a rough quantitative guide but also a useful qualitative account of the flow pattern produced by the passage of a shock through an impressed field. A.

538.3 : 532.5

6070. HYDROMAGNETIC STABILITY OF A CONDUCTING FLUID IN A CIRCULAR MAGNETIC FIELD. F.N.Edmonds, Jr.
Phys. of Fluids, Vol. 1, No. 1, 30-41 (Jan.-Feb., 1958).

The theory of viscous flow between two rotating coaxial cylinders as developed by Taylor and Chandrasekhar is extended to the case when the fluid is an electrical conductor and a circular magnetic field (i.e. one whose lines of force are concentric with the cylinder walls) is present. The equations governing marginal stability are derived, and boundary conditions for perfectly conducting cylinders (Fermi boundary conditions) are formulated for two cases when the difference in cylinder radii is small compared with their mean. In the first case, co-rotating cylinders, the underlying charac teristic value problem is solved by a variational method devoloped by Chandrasekhar to show that convective instability rather than oscillatory overstability will occur for realizable magnetic field strengths. In the second case, co-rotating and counter-rotating cylinders, the underlying characteristic value problem is solved by an expansion in orthogonal functions method developed by Chandrasekhar to determine critical Taylor numbers for marginal stability. The magnetic field inhibits the onset of instability, but this effect is quite small as the hydromagnetic interaction involves displacement but the distortion of the magnetic lines of force. A.

538.3 : 532.5

6071. ON SPHERICAL VORTICES IN MAGNETOHYDRODYNAMICS. C.Agostinelli.
R.C. Accad. Naz. Lincei, Vol. 24, No. 1, 35-42 (Jan., 1958).
In Italian.

A solution of the hydromagnetic equations for an infinitely conducting liquid in the presence of a uniform magnetic field is obtained, corresponding to Hill's spherical vortex in hydrodynamics.

Expressions are obtained for the internal and external velocity and magnetic field components, and it is shown that the centre of the vortex moves with uniform velocity in the direction of the applied field. R.A.Newing

538.3 : 532.5

6072. SOME PROBLEMS OF MAGNETOGASDYNAMICS ALLOWING FOR FINITE CONDUCTIVITY.
G.S.Golytsyn and K.P.Stanyukovich.
Zh. éksper. teor. Fiz., Vol.33, No. 6(12), 1417-27 (1957).
In Russian.

It is shown that if space finite conductivity is taken into account, the magnetogasdynamic equations become parabolically degenerate. The equation set is replaced by one that is approximate but of a completely hyperbolic type and characteristics are found for the latter set. It is shown that the equations of a stationary unidimensional flow have a singularity at the point where the flow velocity is equal to the local sound velocity. Conditions of transition of the flow current through this critical value under the action of a magnetic field are investigated. Small oscillations in a conducting medium, shock waves and the structure of the shock wave front are investigated. A.

ELECTROMAGNETIC WAVES AND OSCILLATORS

538.56

6073. EXACT NONLINEAR PLASMA OSCILLATIONS.
I.B.Bernstein, J.M.Greene and M.D.Kruskal.
Phys. Rev., Vol. 108, No. 3, 546-50 (Nov. 1, 1957).

The problem of a one-dimensional stationary nonlinear electrostatic wave in a plasma free from interparticle collisions is solved exactly by elementary means. It is demonstrated that, by adding appropriate numbers of particles trapped in the potential-energy troughs, essentially arbitrary travelling wave solutions can be constructed. When one passes to the limit of small-amplitude waves it turns out that the distribution function does not possess an expansion whose first term is linear in the amplitude, as is conventionally assumed. This disparity is associated with the trapped particles. It is possible, however, to salvage the usual linearized theory by admitting singular distribution functions. These, of course, do not exhibit Landau damping, which is associated with the restriction to well-behaved distribution functions. The possible existence of such waves in an actual plasma will depend on factors ignored in this paper, as in most previous works, namely interparticle collisions, and the stability of the solutions against various types of perturbations. A.

538.561 : 530.145

6074. A SATURATION EFFECT IN A SYSTEM WITH THREE ENERGY LEVELS. V.M.Faĭn.
Zh. éksper. teor. Fiz., Vol. 33, No. 5(11), 1290-4 (1957). In Russian.

Behaviour of a system with three levels E_1, E_2 and E_3 is considered under the action of a h.f. alternating field that has harmonics with frequencies $\omega_{31} = (E_3 - E_1)/\hbar$, $\omega_{32} = (E_3 - E_2)/\hbar$ and $\omega_{21} = (E_2 - E_1)/\hbar$. An expression is found for dielectric permittivity or magnetic permeability which may be used in the theory of quantum generators or amplifiers. A.

538.561 : 621.375.9

6075. ON NON-LINEAR EFFECTS OF THE INTERACTION OF RESONANCE FIELDS IN A MOLECULAR GENERATOR OR AMPLIFIER. V.M.Kontorovich and A.M.Prokhorov.
Zh. éksper. teor. Fiz., Vol. 33, No. 6(12), 1428-30 (1957). In Russian.

An investigation of position of possible frequencies of generation and amplification taking into account saturation of the auxiliary field is carried out on basis of an analysis of the polarizability of a quantum system situated in two resonance fields. It is shown that the generator and amplifier can operate at two frequencies which depend on the amplitude as well as frequency of the auxiliary field. A.

538.566 : 538.614

6076. INVESTIGATION OF TEMPERATURE DEPENDENCE OF SOME PROPERTIES OF FERRITES IN THE CENTIMETRE REGION.
V.A.Kiseleva and E.I.Kondorskiĭ.
Dokl. Akad. Nauk SSSR, Vol. 119, No. 5, 926-8 (1958). In Russian.

Temperature dependence of the angle of rotation of the polarization plane was experimentally investigated for 3.2 cm waves, in Ni—Mg ferrites, in the temperature range from −196° to +220°C. Five different compositions were investigated and the angle of rotation of the polarization plane was measured at different field strengths, as well as the elliptic ratio and the attenuation of the waves propagated through a ferrite specimen situated in a longitudinal permanent magnetic field. The method of measurement is described. The waveguide with the measured ferrite was kept in a Dewar vessel which could be filled with dry ice or liquid nitrogen. Varying magnetic field, up to 5500 Oe, was generated by a water-cooled solenoid. Results of measurements are reproduced, and the conclusion is reached that with increasing temperature the resonance region moves towards lower fields which is apparently associated with the change in anisotropy. J.M.Silberstein

538.566

6077. INTRODUCTION TO THE MODERN THEORY OF ELECTROMAGNETIC DIFFRACTION. G.Toraldo di Francia.
Atti. Fond. Ronchi, Vol. 11, No. 6, 503-51 (Nov.-Dec., 1956).

This paper gives an account of the author's lectures on selected topics in electromagnetic diffraction, under the following headings: preliminary discussion on Kirchhoff's theory; the Larmor—Tedone formulae; Sommerfeld's solutions; integro-differential equations of electromagnetic diffraction and Babinet's principle; transmission and scattering cross-sections; the variational method of Levine and Schwinger; diffraction at a screen with unidirectional conductivity. P.M.Davidson

538.566 : 621.371

6078. THE CHARACTERISTICS OF AN ELECTROMAGNETIC WAVE REFLECTED FROM A MOVING OBJECT. C.F.Cole, Jr.
J. Franklin Inst., Vol. 265, No. 6, 463-72 (June, 1958).

A theoretical study is carried out to investigate the difference in the properties of an electromagnetic wave reflected from a fixed object and a moving object. Solutions of a wave equation in rectangular coordinates are used with different boundary conditions for the determination of the reflected wave characteristics. The variation in the values of angle of incidence and reflection with time, as an object moves, are shown to be related to Doppler frequency as well as the relative velocity. Expressions for an electromagnetic wave reflected from both the fixed and moving object are given. A relationship between relative velocity with respect to the source of incident wave and the reflected wave frequency and amplitude is described. A.

538.566

6079. AN APPROXIMATE TREATMENT OF HIGH-FREQUENCY SCATTERING. D.S.Jones and G.B.Whitham.
Proc. Cambridge Phil. Soc., Vol. 53, Pt 3, 691-701 (July, 1957).

Expressions for the scattering area coefficient (σ) of a cylinder are deduced by the methods of geometrical optics, in a manner which is simpler than that of Kodis (I.R.E. Trans Antennas and Propagation, Vol. AP-4, No. 3, 580, 1956). A value of $\sigma = 2 \mp 0.985\ (ka)^{-2/3}$ (where k is the wave-number and a the radius of the cylinder) agrees reasonably with the exact treatment of Rubinow and Wu (Abstr. 8877/1956). This success suggests a similar treatment for bodies of arbitrary shape giving an expression for σ in terms of an integral round the edge of the shadow boundary of an obstacle; this reduces for a sphere to $\sigma = 2 \mp 1.97\ (ka)^{-2/3}$. G.F.Lothian

538.566

6080. COMMENTS ON THE TREATMENT OF DIFFRACTION OF PLANE WAVES: ADDENDUM TO "THE EDGE CONDITIONS AND FIELD REPRESENTATION THEOREMS IN THE THEORY OF ELECTROMAGNETIC DIFFRACTION". A.E.Heins and S.Silver.
Proc. Cambridge Phil. Soc., Vol. 54, Pt 1, 131-3 (Jan., 1958).

Some points of difficulty are discussed more fully than in the original paper (Abstr. 2903/1955). P.M.Davidson

538.566 : 621.372.8

6081. INFLUENCE OF WALL LOSSES ON PULSE PROPAGATION IN WAVE GUIDES. R.Gajewski.
J. appl. Phys., Vol. 29, No. 1, 22-4 (Jan., 1958).

Assuming that the resistivity of waveguide walls is not too large, the influence which energy losses have upon the shape of a pulse propagating along the waveguide is discussed. It is found that pulses are damped with a damping factor equal in the first approximation to that in a steady state. A.

538.566 : 621.371

6082. ELECTROMAGNETIC RADIATION PATTERNS AND SOURCES. C.Müller.
New York Univ. (Inst. Math. Sci.), Rep. EM-95, 224-32 (July, 1956).

Derives asymptotic expansions (for large r) relating electric

or magnetic field to a vector F defining a particular radiation pattern. F is a complex-valued vector-field, defined on the unit sphere with no component in the direction of the normal. By determining the necessary and sufficient conditions for F to represent a radiation pattern it can be determined whether there exists an electromagnetic field such that the asymptotic expansions are satisfied. (New York Univ. (Inst. Math. Sci.), Rep. GM-62, March, 1954). G.D.Sims

538.566.2 : 621.371

6083. NONRECIPROCAL ELECTROMAGNETIC WAVE PROPAGATION IN IONIZED GASEOUS MEDIA. L.Goldstein. I.R.E. Trans Microwave Theory and Tech., Vol. MTT-6, No. 1, 19-29 (Jan., 1958).

The classical Faraday experiment in the optics of anisotropic media has suggested an analogous phenomenon at microwave frequencies. The anisotropic behaviour of the free electron gas which is immersed in a magnetic field and subjected to an incident electromagnetic wave is determined. Guided microwave experiments were performed which confirm the theoretical predictions of nonreciprocal wave propagation in such ionized gases. Experimental observations are reported. A.

538.566.2 : 551.515

VERTICAL MOTION IN THE ATMOSPHERE AND ITS EFFECT ON V.H.F. RADIO SIGNAL STRENGTH. See Abstr. 5546

538.566.3

6084. AN EXTENSION TO THE MODE THEORY OF V.L.F. IONOSPHERIC PROPAGATION. J.R.Wait. J. geophys. Res., Vol. 63, No. 1, 125-35 (March, 1958).

The waveguide mode theory of v.l.f. propagation for a sharply-bounded homogeneous ionosphere is refined to include stratification at the lower edge of the ionosphere. The numerical results for a two-layer model are discussed in detail. By choosing the upper medium to have a conductivity with a factor of 10 greater than the lower medium, the attenuation v. frequency characteristic of the model is consistent with experimental data from 1.0 to 20 kc/s. The effect of the finite thickness of the E layer, important for frequencies less than 1.0 kc/s, is treated by an ionospheric model which has a sharp lower edge and an exponential taper to zero at greater heights. A.

538.566.3

6085. RAY-TRACING TECHNIQUE IN A HORIZONTALLY STRATIFIED IONOSPHERE USING VECTOR REPRESENTATIONS. R.J.Marcou, W.Pfister and J.C.Ulwick. J. geophys. Res., Vol. 63, No. 2, 301-13 (June, 1958).

Vector expressions are derived for tracing oblique ray paths, taking into account the full effect of the earth's magnetic field. In particular, the unit vector S in the direction of the ray, and the vector expressions for the equivalent path of the wave packet and the group refractive index, are derived. A method for high-speed computers is described for ray tracing in a horizontally stratified ionosphere, for determining, by an iteration process, the index of refraction and wave normal direction, and for determining electron-density distributions from rocket data. A.

538.566.3

6086. EFFECT OF THICKNESS OF IONOSPHERIC LAYER ON THE SEPARATION OF MAGNETO-IONIC SPLIT ECHOES. C.L.Bai. J. sci. industr. Res., Vol. 17B, No. 2, 83-7 (Feb., 1958).

Measurements show that the separation of the o and x components of a radio-wave near the critical frequency decreases with increase of the semi-thickness of the layer, in contradiction of the theory. It is suggested that this is due to the effect of increased absorption of the o-wave as the thickness of the layer increases, so that the maximum observed separation of the split echoes becomes reduced. G.M.Brown

NUCLEAR AND ATOMIC PHYSICS APPARATUS. PARTICLE DETECTORS

539.1.07

6087. THE NATURE OF THE PHOTOSENSITIVITY OF GEIGER COUNTERS. H.O.Albrecht and C.E.Mandeville. J. Franklin Inst., Vol. 265, No. 6, 473-82 (June, 1958).

Some aspects of the photosensitivity of the Geiger counter are discussed. Methods for increasing response to ultraviolet and near ultraviolet photons are described. The photosensitivity is traced to formation of a surface film upon the inner wall of the cathode, that is, a quasi-metallic alkyl coating is assumed to be formed. Relatively short wave radiation of sufficient energy to form free radicals in hydrogen and organic quenching gases is required to increase ("activate") the sensitivity. A.

539.1.07

6088. ON THE HYSTERESIS EFFECT OF MICA END-WINDOW GEIGER-MÜLLER COUNTER TUBES. J.Akutsu. J. Sci. Res. Inst. (Tokyo), Vol. 52, 11-16 (March, 1958).

G.M. counter tubes with a metal envelope and a mica end-window coated externally with a conductive material cause a hysteresis effect which is evidenced by the difference in counting rates when the voltage in the plateau region is traversed in ascending and descending directions. This hysteresis effect is eliminated by the use of an opaque varnish film in place of the conductive material. A.

539.1.07

6089. PHOTO-IONIZATION IN SELF-QUENCHING GEIGER COUNTERS. R.M.Chaudri, M.Y.Khan, A.Khawaja and R.Dar. Nature (London), Vol. 181, 1526-7 (May 31, 1958).

Describes experiments on the discharge in argon–alcohol filled counters. The authors conclude that u.v. radiations from excited argon atoms give rise to photo-ionization of the alcohol vapour. J.W.Sturgess

539.1.07

6090. ON DISCHARGE SPREADING IN SELF-QUENCHED COUNTER TUBES. II. E.Huster and E.Ziegler. Z. Phys., Vol. 149, No. 5, 583-93 (1957). In German.

For Pt I see Abstr. 2347 (1957). A further detailed description of experiments on discharge spread in divided-cathode self-quenched counters of the Geiger–Müller type. Argon–ethyl alcohol fillings were particularly studied. Absorption measurements were made for the active photons and the results are discussed in relation to previous work. J.D.Craggs

539.1.07 : 535.33.07

IODINE-VAPOUR-FILLED ULTRAVIOLET PHOTON COUNTER. See Abstr. 5769

539.1.07

6091. ADVANCES IN THE STANDARD PROPORTIONAL COUNTER METHOD OF FAST NEUTRON DOSIMETRY. E.B.Wagner and G.S.Hurst. Rev. sci. Instrum., Vol. 29, No. 2, 153-8 (Feb., 1958).

The proportional counter method for measuring fast neutron dose in the presence of gamma radiation has been considerably improved through: (1) redesign of the proportional counter; (2) a study of the behaviour of the counter for various filling gases; and (3) development of a more convenient form of the electronics necessary for pulse integration and dose indication. The instrument is suitable for radiobiological research, neutron physics, and shielding research, as well as radiation protection. It is shown that the response of the instrument is within ± 5% of tissue-absorbed dose over the energy range from 0.5 to 14 MeV. A.

539.1.07

6092. NEUTRON DETECTORS FOR THE HARWELL FAST CHOPPER. K.P.Nicholson and J.W.Hall. Atomic Energy Res. Establ. (Harwell), Mem. N/M76, 11 pp. (1956).

The criteria by which a detector is assessed for use with a neutron time-of-flight spectrometer are surveyed, with particular reference to the requirements of the Harwell fast chopper. The properties of BF_3 gas-filled counters and various types of neutron scintillation counter are discussed, and compared with these criteria. Most of the experimental details were obtained directly by setting up the detectors on the machine. It was found that the most suitable detector is either the B_2O_3–ZnS(Ag) fused-disk scintillator, or a bank of small diameter BF_3 proportional counters. The other scintillation detectors proved to be unsuitable because of their high sensitivity to background gamma radiation. A.

539.1.07

6093. ON THE ENERGY AND PULSE SPECTRA OF A FAST IONIZATION CHAMBER. C.Cernigoi and G.Pauli. Nuovo Cimento, Vol. 8, No. 5, 754-61 (June 1, 1958).

An analytical investigation is carried out on the influence of geometrical factors of a pulse ionization chamber on the correspondence between energy and pulse spectra. General formulae are given for plane, cylindrical and spherical chambers. The method is suitable for practical cases and examples are given. A.

539.1.07 : 535.376

6094. DECAY TIME OF THE LUMINESCENCE OF A ZINC SULPHIDE NEUTRON DETECTOR FOR NEUTRON AND γ-RAY EXCITATION. G.M.Bailey and J.R.Prescott.
Austral. J. Phys., Vol. 11, No. 1, 135-8 (March, 1958).

The rise-times of the integrated pulses were measured oscillographically, and the decay time of the phosphor deduced from an expression proved by measurements on scintillators of known decay-times. The γ-excitation gave a rapid decay of 8.5 ± 2.5 mμsec as well as the long-term phosphorescence of ZnS(Ag), while a much slower complex decay was observed for neutrons, consistent with the slow recombination following the heavily ionizing protons from n–p scattering and the $S^{32}(n,p)P^{32}$ reaction in the phosphor.
A.E.I. Research Laboratory

539.1.07 : 537.591.1

6095. A LARGE-AREA LIQUID SCINTILLATION COUNTER AND SOME MEASUREMENTS ON HIGH-ENERGY COSMIC-RAY PARTICLES. C.H.Millar, E.P.Hincks and G.C.Hanna.
Canad. J. Phys., Vol. 36, No. 1, 54-72 (Jan., 1958).

A liquid scintillation counter is described which consists of a $29\frac{3}{4} \times 29\frac{3}{4} \times 2$ in. Plexiglas tanks of terphenyl plus α-naphthylphenyloxazole (αNPO) in triethylbenzene. The tank is surrounded by MgO powder and viewed by a total of eight R.C.A. type 5819 photomultiplier tubes along two opposite edges. For normally incident fast μ-mesons a peaked pulse-height distribution is observed, 20.5% in width at half-maximum for the central area of the counter, broadening to 25-30% at the perimeter, and estimated to be 25% over-all. When the Landau distribution in energy loss (width 18% at half-maximum) and the geometric spread are taken into account, a counter resolution function 8% in width at half-maximum is obtained for the central area of the counter, or 18% for the counter as a whole. The most probable pulse-height for 0.30 GeV μ-mesons is 1.6 ± 0.5% higher than for 2.2 GeV μ-mesons, in close agreement with the Bethe–Bloch theory as extended by Symon and with a density correction calculated by the method of Sternheimer. Pulse heights from protons in the region from 0.3 to 0.8 GeV vary directly with the theoretically computed energy loss in the counter. Peak position and resolution are unchanged by a flux of 12 mr/hr of thorium γ-rays.
A.

539.1.07

6096. RESPONSE OF AN ANTHRACENE SCINTILLATION COUNTER TO 10-120 keV ELECTRONS. L.W.Johnston, R.D.Birkhoff, J.S.Cheka, H.H.Hubbell, Jr and B.G.Saunders.
Rev. sci. Instrum., Vol. 28, No. 10, 765-7 (Oct., 1957).

Monoenergetic electrons from an electron accelerator were incident on a thin bare anthracene crystal centred on the photocathode of a R.C.A. 6199 photomultiplier. A linear amplifier and single channel analyser were used to obtain a pulse-height distribution at each energy. The pulse height at the maximum of the distribution is a linear function of the incident electron energy with intercepts of 4.5 and 3.5 keV for 0.060 and 0.011 in. thick crystals, respectively. The pulse-height distribution could be fitted well with a Gaussian. The data indicate a linear relationship between the square of the full width of the pulse-height distribution and 1/e of the maximum and the electron energy. The average amount of electron energy absorbed in the crystal required to produce a photoelectron at the photocathode is 1.47 ± 0.09 keV/photoelectron for the 0.060 in. crystal and 1.32 ± 0.13 keV/photoelectron for the 0.011 in. crystal. A.

539.1.07

6097. DOSIMETER FOR HIGH-ENERGY NEUTRONS.
P.S.Baranov, V.I.Goldanskii and V.S.Roganov.
Rev. sci. Instrum., Vol. 28, No. 12, 1029-32 (Dec., 1957).

A neutron detector with a threshold at 20.6 MeV is described, which is based on the $C^{12}(n,2n)C^{11}$ reaction in liquid organic scintillators. The efficiency of the detector is almost independent of neutron energy from ~ 40 to ~ 400 MeV. The detector can be used to measure with an error of 6% high-energy neutron fluxes in the tolerance range (20-50 neutron $cm^{-2}sec^{-1}$). A.

539.1.07 : 778.34

6098. SCINTILLATION CAMERA. H.O.Anger.
Rev. sci. Instrum., Vol. 29, No. 1, 27-33 (Jan., 1958).

A sensitive gamma-ray camera for visualizing sources of radioactivity is described. It consists of a lead shield with a pinhole aperture, a scintillating crystal within the shield viewed by a bank of seven photomultiplier tubes, a signal matrix circuit, a pulse-height selector, and a cathode-ray oscilloscope. Scintillations that fall in a certain range of brightness, such as the photopeak scintillations from a gamma-ray-emitting isotope, are reproduced as point flashes of light on the cathode-ray-tube screen in approximately the same relative positions as the original scintillations in the crystal. A time exposure of the screen is taken with an oscilloscope camera, during which time a gamma-ray image of the subject is formed from the flashes that occur. One of many medical and industrial uses is described, namely the visualization of the thyroid gland with I^{131}.
A.

539.1.07

6099. POLYVINYL CHLORIDE — NEW HIGH-LEVEL DOSIMETER. C.Artandi and A.A.Stonehill.
Nucleonics, Vol. 16, No. 5, 118, 120 (May, 1958).

A rigid, non-plasticized polyvinyl chloride film is found to be a good dosimeter for electron doses from 0.5 to 6 megarad. After irradiation the film is kept at 120° F for 4 hr and the resulting amber colour estimated visually or spectrophotometrically. R.D.Smith

539.1.07

6100. THE USE OF THE NEON FLASH-TUBE FOR THE PRECISE LOCATION OF PARTICLE TRAJECTORIES.
F.Ashton, S.Kisdnasamy and A.W.Wolfendale.
Nuovo Cimento, Vol. 8, No. 4, 615-21 (May 16, 1958).

The passage of fast cosmic-ray particles through an array of neon flash-tubes was studied and the accuracy of location of the particle trajectories was found to be as high as in conventional cloud chambers. A.

539.1.07

6101. NUCLEAR PARTICLE TRACK PHOTOGRAPHY IN ELECTRIC FIELDS. I.E.Bock.
Phil. Mag. (Eighth Ser.), Vol. 3, 715-17 (July, 1958).

A method is proposed whereby the light emitted by liquid scintillators may be increased by application of a suitable a.c. field. It is calculated that by this means the light output may be increased amply to allow minimum ionizing tracks to be recorded photographically without the possibility of instability arising. A.

539.1.07

6102. ON THE THEORY OF THE BUBBLE CHAMBER. Yu.Kagan.
Dokl. Akad. Nauk SSSR, Vol. 119, No. 2, 247-50 (1958). In Russian.

An attempt is made to interpret the mechanism of bubble formation in a bubble chamber, and the experimental data are presented for the dependence of the track density on the velocity of a particle. The density of energy lost by the particle is calculated as a function of the distance from the path of the particle, and it is assumed that subcritical nuclei will grow into visible bubbles if they find themselves in the region where at least a given fraction of this energy is localized. In this way the dependence of the bubble density on the velocity β of the particle is found to be of the form $1/\beta^2$.
G.Martelli

539.1.07

6103. ON THE THEORY OF THE BUBBLE CHAMBER. F.Seitz.
Phys. of Fluids, Vol. 1, No. 1, 2-13 (Jan.-Feb., 1958).

An attempt is made to analyse the factors which determine the operation of the bubble chamber. It is concluded that the majority of bubbles in conventional chambers are nucleated by moderately energetic free electrons produced by the incident particles in Coulomb encounters. Nuclei are displaced too infrequently by Coulomb encounters to account for the observed densities of bubbles. The electrons deposit their kinetic energy in highly localized regions which then are the source of explosions which produce bubbles of greater than critical size in a time of the order of 10^{-10} or 10^{-11} sec. The bubbles grow subsequently by evaporation of the fluid. The temperature of the fluid should be sufficiently close to the critical temperature so that the energy required to produce the bubble of critical size can be provided by an electron with a range comparable to or less than the diameter of the bubble of critical size. Otherwise the electron will be unable to localize its energy in a sufficiently small volume in any but highly improbable cases. It is also concluded that the viscosity of the liquid plays a very important role in determining the threshold energy for forming a bubble of critical size when it has a value near 1 centipoise or larger. A.

539.1.07

6104. THE EFFECT OF FLUCTUATIONS OF THE SPECIFIC LOSS OF ENERGY ON THE GRAIN DENSITY IN THE NEIGHBOURHOOD OF MINIMUM IONIZATION.
M.Morand, M.C.Le Gentil and S.Desprez-Rebaud.
C.R. Acad. Sci. (Paris), Vol. 246, No. 13, 1991-2 (March 31, 1958). In French.

Calculations show that the theoretical values are in better agreement with those from experiments, when allowance is made for such fluctuations. E.J.Burge

539.1.07

6105. THE NATURE OF THE TAPER TRACKS OF HEAVY IONS IN NUCLEAR EMULSIONS. O.Skjeggestad.
Nuovo Cimento, Vol. 8, No. 6, 927-35 (June 16, 1958).

The thinning down of the tracks of heavy ions as they approach the end of their range in electron sensitive photographic emulsion, can be quantitatively explained on the assumption that the thickness of the developed track is due mainly to δ-rays which no longer have sufficient range at low ion velocities to broaden the track. A.

539.1.07

6106. SEMIAUTOMATIC SCATTERING MEASUREMENTS IN NUCLEAR EMULSIONS.
C.Castagnoli, M.Ferro-Luzzi and M.Muchnik.
Nuovo Cimento, Vol. 8, No. 6, 936-42 (June 16, 1958).

A simple semiautomatic device is described for scattering measurements and computations in nuclear emulsion work. Advantages of the system are its low cost and a minimum time gain of 4 or more depending on the type of measurements. A.

539.1.07 : 77.023.7

6107. ON THE CLEARING OF EMULSION PLATES.
Y.Prakash, N.Ahamad and A.P.Sharma.
Nuovo Cimento, Vol. 8, No. 5, 717-30 (June 1, 1958).

The effect of the addition of ammonium chloride, ammonium hydroxide, and ammonium sulphocyanide to the hypo bath of different concentrations, on the clearing time of thin and thick emulsions (up to 1000 μm) was determined. In the case of thin emulsions no rise for higher concentrations was found. A detailed study of the three baths for different concentrations of ammonium salts was made, and the results indicate an optimum value for a particular temperature and thickness. The effects of the ammonium baths on developed grain size was also studied. The results are discussed on the basis of present theory. The use of ammonium sulphocyanide is favoured in comparison to the other two salts. A.

539.1.07

6108. THE CONSTRUCTION AND OPERATION OF A SINGLE CRYSTAL NEUTRON SPECTROMETER.
N.J.Pattenden and A.H.Baston.
Atomic Energy Res. Establ. (Harwell), Rep. NP/R2251, 15 pp. (1957).

A detailed description is given of a spectrometer employing a beryllium monochromator. Some experimental results obtained with the instrument are briefly mentioned. A.

539.1.07 : 538.222

AUTOMATIC FREQUENCY CONTROL FOR NUCLEAR MAGNETIC RESONANCE SPECTROMETER. See Abstr. 6053

ELEMENTARY PARTICLES

539.12

6109. SEARCH FOR A LONG LINED CHARGED PARTICLE.
P.Stein.
Phys. Rev. Letters, Vol. 1, No. 1, 21 (July 1, 1958).

A search has been made for a particle of about 500 electron masses, in the γ-ray beam of the Cornell electron synchrotron, with a counter detecting system. The detection scheme assumes a lifetime of from 100 μsec to 1 msec, at least one charged decay product with the range of a 25 MeV electron, and positive charge (or if charge is negative, that decay occurs before absorption). If the particles are produced in pairs, and the lifetime is taken as 150 μsec, an average upper limit can be set to the cross-section, from 550 to 1100 MeV, of 4×10^{-33} cm²/nucleon. P.Rothwell

539.12

6110. ON THE MASS SPECTRUM OF ELEMENTARY PARTICLES.
R.Reulos.
Arch. Sci. (Geneva), Vol. 11, No. 1, 112-13 (Jan.-March, 1958). In French.

An empirical rule is suggested, relating particle masses to the fine structure constant, the unit of charge and the gravitational constant. There are three free parameters; suitable integer values give the electron, τ, $\pi^{\pm}$ and π^{0} masses approximately.

R.J.N.Phillips

539.12 : 539.1.07

6111. A METHOD TO DETERMINE THE CHARGE OF PARTICLES STOPPING IN NUCLEAR EMULSIONS. T.Johansson.
Ark. Fys., Vol. 13, No. 2, Paper 12, 129-44 (1958).

An investigation is described of a photometric method for the determination of the charge of particles stopping in nuclear emulsions. The image of the track in the emulsion was projected on a narrow slit placed in front of a photomultiplier and moved perpendicularly across the slit. The slit was parallel to the direction of the track and the absorption of light was measured by means of the photomultiplier and a recording instrument. The resolving power depends on the available track length, the quality and the degree of development of the emulsions. If track lengths of 100 μ are used in normally developed G5 emulsions of good quality it is possible to separate doubly and singly charged particles in about 95% of the cases, the resolution being better for multiply charged particles. A.

539.12

6112. SOLID ANGLE CORRECTIONS TO SINGLE SCATTERING.
F.F.Heymann and P.I.P.Kalmus.
Brit. J. appl. Phys., Vol. 9, No. 7, 271-2 (July, 1958).

Corrections relating the average intensity of particles scattered into an aperture of finite solid angle to the intensity at the centre of the aperture are given for rectangular and circular apertures. The dependence of the corrections on aperture shape and scattering angle is calculated for electrons scattered according to the simple Mott formula. A.

539.12

6113. INVERSE DISPERSION RELATIONS.
V.Z.Blank and D.V.Shirkov.
Zh. éksper. teor. Fiz., Vol. 33, No. 5(11), 1251-3 (1957). In Russian

"Inverse" dispersion relations relating the imaginary part of the scattering amplitude with a Cauchy-type integral of the real part of the scattering amplitude are considered. The integral over the unobserable region is calculated using ordinary ("direct") dispersion relations. Concrete discussion is given for the forward-scattering amplitude of charged pions on nucleons For this case, the physical inverse dispersion relations that do not contain unobservable quantities are written down in the explicit form. A.

539.12 : 530.145

AN INVARIANT REPRESENTATION OF THE SCATTERING MATRIX. See Abstr. 5647

539.12

6114. MULTIPLE PRODUCTION OF HEAVY PARTICLES IN TWO NUCLEON COLLISIONS. V.S.Barashenkov, B.M.Barbashev, E.G.Bubelov and V.M.Maksimenko.
Nuclear Phys., Vol. 5, No. 1, 17-22 (Jan., 1958).

The probabilities of particle production in nucleon–nucleon collisions at an energy of E = 5 GeV were calculated using Fermi's statistical theory and by taking into account the conservation of baryon number, strangeness, isobaric spin as well as strong resonance pion–nucleon interaction in the T = 3/2, P = 3/2 state. Various effective space volumes in which secondary particles are produced were considered. A.

539.12: 539.17

MULTIPLE PARTICLE PRODUCTION. See Abstr. 5339

539.12 : 530.145

NON-LOCAL THEORY OF ELEMENTARY PARTICLES. See Abstr. 5635

539.12

6115. AGE EQUATION FOR γ-QUANTA. B.V.Novozhilov.
Zh. éksper. teor. Fiz., Vol. 33, No. 5(11), 1287-9 (1957). In Russian.

An equation is obtained for the distribution function of multiply scattered γ-quanta of low energy ($E \ll m_0c^2$), similar to the age equation for neutrons. The distributions of quanta in space and wavelengths are in satisfactory agreement with the numerical solution of the kinetic equation. A.

539.12

6116. APPROXIMATE EQUATIONS FOR SCATTERING AMPLITUDE OF PHOTONS BY NUCLEONS.
A.N.Tavkhelidze and V.K.Fedyanin.
Dokl. Akad. Nauk SSSR, Vol. 119, No. 4, 690-3 (1958). In Russian.

The nucleon is represented as a charged meson cloud. The scattering-matrix equations for the quantum-electrodynamic interactions between this charge distribution and the photon-radiation field are then formulated as far as the fourth-order radiation terms, and their solutions discussed. J.W.Gardner

539.12

6117. DISPERSION RELATIONS FOR REACTIONS WITH A VARIABLE NUMBER OF PARTICLES. A.A.Logunov.
Dokl. Akad. Nauk SSSR, Vol. 120, No. 3, 501-3 (1958). In Russian.

Dispersion relations for the double Compton effect, $\gamma + p \rightarrow 2\gamma + p$, are derived. G.E.Brown

539 12

6118. REFORMULATION OF THE THEORY OF THE NEUTRINO. S.Kamefuchi.
Nuclear Phys., Vol. 7, No. 4, 411-20 (July [1], 1958).

A reformulation of the theory of the neutrino is attempted by generalizing the free Lagrangian so as to include from the outset terms violating parity and particle number conservations. It is shown that, so far as the free field is concerned, this generalized field is equivalent to the usual field and that a difference appears only when interactions are included. An application is also given to the discussion of coupling constant invariants of β-decay. A.

539.12

6119. CONSTRUCTION OF A SOLUTION WITH MOVABLE SINGULARITY FOR THE EQUATIONS OF THE NEUTRINO WITHOUT EXTERNAL FIELD. T.Mumm.
C.R. Acad. Sci. (Paris), Vol. 246, No. 11, 1673-4 (March 17, 1958). In French.

539.12

6120. ON THE THEORY OF THE NEUTRINO WITH ORIENTED SPIN. A.A.Sokolov.
Zh. éksper. teor. Fiz., Vol. 33, No. 3(9), 794-6 (1957). In Russian.

A theory of the neutrino and antineutrino is developed from the Dirac equation, and the relation to Majorana's theory discussed. The present theory prohibits double beta-decay. J.W.G.Wignall

539.12

6121. REST MASS OF THE NEUTRINO. J.J.Sakurai.
Phys. Rev. Letters, Vol. 1, No. 1, 40-2 (July 1, 1958).

Assuming a beta-decay interaction with the property $C_i = \pm C_i'$ for each i, it follows that a non-zero neutrino mass would affect the beta-spectrum through the phase space factor only. As a consequence, the beta end-point obtained by extrapolating according to the ordinary Kurie plot gives no information about the neutrino mass, but a measurement of the shape of the end of the spectrum would give an unambigous value for the mass. J.C.Taylor

539.12 : 530.145

"NEUTRINO CHARGE" IN WEAK AND STRONG INTERACTIONS. See Abstr. 5630

539.12

6122. TABLES OF AVERAGE NUMBERS FOR ELECTRON—PHOTON SHOWERS AT SMALL DEPTHS OF ABSORBER.
J.C.Butcher, B.A.Chartres and H.Messel.
Nuclear Phys., Vol. 6, No. 2, 271-8 (March [3], 1958).

Accurate numerical results for the average numbers of electrons and photons at small depths of absorber, in an electron—photon shower, have not hitherto been available. Results are now presented for the average numbers in approximation A, for small depths. The calculations were performed using the digital computer Silliac. A.

539.12

6123. EXPERIMENTAL DATA ON CASCADE MULTIPLICATION OF ELECTRONS IN LEAD. M.I.Daĭon.
Zh. éksper. teor. Fiz., Vol. 33, No. 5(11), 1175-8 (1957). In Russian.

Experimental data were obtained on the number of secondary electrons at depths of 1.4, 2.8, 4.2 t-units (Pb) for primary electron energies of 200-500 MeV. A comparison was made with theoretical calculations carried out by the Monte Carlo method. A.

539.12

6124. DOUBLE SCATTERING OF ELECTRONS.
H.Schneider and E.Barnard.
Nuovo Cimento, Vol. 8, No. 5, 770-2 (June 1, 1958).

Gold—gold double scattering experiments at energies between 60 and 100 keV give asymmetries which are about half those that are predicted theoretically. W.O.Lock

539.12

6125. CALCULATION OF ELECTRON—ELECTRON SCATTERING.
P.Stehle.
Phys. Rev., Vol. 110, No. 6, 1458-60 (June 15, 1958).

The matrix elements involved in the calculation of electron—electron and positron—electron scattering are written down explicitly for a complete set of initial and final spin states of the particles. This permits the evaluation of the cross-section for any polarization combination desired, with a minimum of labour. A.

539.12 : 539.18

POLARIZATION AND EXCHANGE EFFECTS IN THE SCATTERING OF ELECTRONS FROM ATOMS. See Abstr. 5437

539.12

6126. ELECTRON AND PHOTON POLARIZATION IN BREMSSTRAHLUNG AND PAIR PRODUCTION.
H.Olsen and L.C.Maximon.
Phys. Rev., Vol. 110, No. 2, 589-90 (April 15, 1958).

The cross-section for bremsstrahlung by arbitrarily polarized electrons was calculated, with the polarization of the resultant photon displayed. Coulomb corrections and screening were included. The corresponding results for pair production are stated. J.C.Taylor

539.12

6127. ANNIHILATION METHOD FOR MEASURING TRANSVERSE POLARIZATION OF ENERGETIC POSITRONS. L.A.Page.
Phys. Rev., Vol. 109, No. 6, 2215-17 (March 15, 1958).

Suggestion that this transverse polarization be measured through the circular polarization of one of the photons from annihilation in flight against unpolarized electrons. R.J.N.Phillips

539.12

6128. ANGULAR CORRELATION OF ANNIHILATION RADIATION IN WATER, ICE AND MERCURY.
P.Colombino, S.De Benedetti, I.Degregori and L.Trossi.
Nuovo Cimento, Vol. 8, No. 3, 508-10 (May 1, 1958).

In mercury no change in the angular correlation is observed during the phase change from solid to liquid. In ice a narrow component is present, which is absent in water. M.A.Grace

539.12

6129. THE INFLUENCE OF THE ELECTRON POLARIZATION ON THE CROSS-SECTION FOR PAIR-ANNIHILATION IN FLIGHT.
W.R.Theis.
Z. Phys., Vol. 150, No. 2, 198-200 (1958). In German.

The differential cross-section for annihilation in flight is calculated for arbitrary orientations of negatron- and positron-spin. The spin-dependence of this process, which provides a method for measuring positron polarization, was calculated independently by Page (Abstr. 5606/1957) for particular polarization-states of the negatron—positron system. P.K.Kabir

539.12 : 539.2

6130. POSITRON ANNIHILATION IN METALS.
E.Daniel and J.Friedel.
J. Phys. Chem. Solids, Vol. 4, No. 1-2, 111-17 (1958). In French.

It is shown that the positron lifetime observed experimentally in metals can be explained on the basis of the polarization of the electron gas in the valency band, without forming positronium. With a screened Coulomb positron—electron interaction a lifetime of 0.7×10^{-10} sec is found, somewhat smaller than the experimental values $1.2 \pm 0.5 \times 10^{-10}$ sec and $2.7 \pm 0.3 \times 10^{-10}$ sec given respectively by Bell and Graham and by Gerholm. The order of magnitude for the experimental results can also be obtained by the cruder approximation of a square-well potential. The dependence on Auger effect of the γ-ray angular correlation is also computed. A.

539.12

6131. ANNIHILATION OF POSITRONS IN ORGANIC COMPOUNDS.
C.R.Hatcher, W.E.Millett and L.Brown.
Phys. Rev., Vol. 111, No. 1, 12-15 (July 1, 1958).

The mean life τ_2 and the fraction I_2 of positrons which decay with a "long" 10^{-9} sec lifetime were measured in several organic compounds, mostly derivatives of benzene. For the long components observed in liquids τ_2 ranges from 1.6×10^{-9} sec to 2.5×10^{-9} sec, whereas I_2 varies from 35% to 4%. A correlation between I_2 and certain properties of the molecules indicates a qualitative explanation of the results. A.

539.12

6132. THE ANGULAR CORRELATION BETWEEN ELECTRON PAIRS CREATED BY γ-RAYS FROM THE π^0-DECAY. E.Karlson.
Ark. Fys., Vol. 13, Paper 1, 1-26 (1957).

The possibility of a direct determination of the intrinsic parity of the neutral π-meson by means of a bubble chamber experiment is investigated. The cross-section for pair production by both the photons from the decay of a neutral π-meson is computed as a function of the angle ψ, defined in the following manner. Each positron—negatron pair defines a plane; ψ is the angle between the projections of these normals on a plane, perpendicular to the photon direction. The cross-section has the form

$$d\sigma/d\psi = \alpha\ (1 \pm \beta^2 \cos 2\psi).$$

The sign is + for a scalar, − for pseudoscalar meson. The computa-

tion gives $\beta^2 = 0.0091$. The Born approximation is used, and the effect of screening is neglected. A.

539.12

6133. SUPPRESSION EFFECT OF THE IONIZATION PRODUCED BY ELECTRON—POSITRON PAIRS OF EXTREMELY HIGH ENERGY. J.Iwadare.
Phil. Mag. (Eighth Ser.), Vol. 3, 680-91 (July, 1958).

The ionization produced by 27 electron—positron pairs with energies between 80 and 2000 BeV, recorded in stacks of emulsion, was studied. The energies were estimated from the development of the soft cascades in an auxiliary experiment. Suppression of the ionization near the origin of the pairs was observed, and the measured effect found to be in satisfactory agreement with theoretical predictions. The observations allow an independent estimate of the energy of the individual pair from the initial ionization, and for pairs with energy ~ 300 BeV most of the values thus obtained were in good accord with those from other methods. There is a correlation between the suppression effect and the disparity in energy of the two particles of a pair. This suggests that ionization measurements give information similar to that provided by studies of the relative scattering of the two components of a pair. A.

539.12 : 537.591.8

DOUBLE PAIR PRODUCTION BY AN ELECTRON. See Abstr. 6024

539.12

6134. LONG τ_2 LIFETIMES FROM POSITRONIUM ANNIHILATION IN LIQUID ARGON AND LIQUID NITROGEN. D.A.L.Paul.
Canad J. Phys., Vol. 36, No. 5, 640-2 (May, 1958).

Using liquids of 99.99% purity a long τ_2 lifetime is found, of $(6.9 \pm 0.7) \times 10^{-9}$ sec in argon and $(11.3 \pm 0.5) \times 10^{-9}$ sec in nitrogen, corresponding to triplet positronium formation. The intensities are 7% and 15%, respectively. It is suggested that the absence of any such effect in previous experiments was due to oxygen impurities, whose magnetic moment caused triplet—singlet transitions. G.H.Burkhardt

539.12

6135. THE EXCITED STATES OF NUCLEONS. N.F.Nelipa.
Zh. éksper. teor. Fiz., Vol. 33, No. 5(11), 1277-81 (1957). In Russian.

It is shown that within the limits of the Markov equation for a nucleon there exist two different classes of excited states: short-lived (nuclear times) and relatively long-lived (10^{-10} sec). These states may be identified with hyperons. Inclusion of hyperons in intermediate states leads to resonance effects. The scattering of negative π-mesons on protons is considered by way of example. The calculated maxima in the total scattering cross-sections are close to the experimentally observed values. A.

539.12

6136. ON THE NUCLEON—ANTINUCLEON INTERACTIONS. M.Gourdin, B.Jancovici and L.Verlet.
Nuovo Cimento, Vol. 8, No. 3, 485-96 (May 1, 1958).

The nucleon—antinucleon cross-sections were calculated at 167 MeV for two different models of complex wells. The first is a Born approximation calculation for a complex Yukawa potential. The second is a machine analysis of a semi-theoretical potential: the real part is an adaptation of the Signell—Marshak potential for the nucleon—antinucleon problem, while the imaginary part is a phenomenological Yukawa potential. To explain the experimental results (large total cross-section but small scattering cross-section) the real part must be weak, whereas the imaginary part must have a range equal to or greater than the usual range of nuclear forces. The fixed source theory of meson—nucleon interaction may perhaps account for the second feature but it is much more difficult to obtain a real potential which is sufficiently small. P.K.Kabir

539.12 : 539.14

6137. SPIN—ORBIT COUPLING IN THE NEUTRON—PROTON INTERACTION. J.L.Gammel and R.M.Thaler.
Phys. Rev., Vol. 107, No. 5, 1337-40 (Sept. 1, 1957).

It is shown that if the nucleon—nucleon interaction is charge-independent, then the n—p scattering and polarization data in the energy range 0-310 MeV require the presence of a spin—orbit term in the triplet even-parity potential of the same short range as (but of somewhat less depth than) the spin—orbit term found previously for the triplet odd-parity potential. A.

539.12

6138. SCATTERING OF NUCLEONS FROM NUCLEI AT HIGH ENERGIES. H.McManus and R.M.Thaler.
Phys. Rev., Vol. 110, No. 2, 590-1 (April 15, 1958).

The phase shifts of Gammel and Thaler (Abstr. 7971/1957 and preceding abstract) are used to calculate the averaged two-nucleon scattering amplitude, whence the multiple-scattering approximation of the nucleon—nucleus scattering amplitude is derived, and shown to be in agreement with experiment from 90 to 310 MeV. Explicit calculations for the scattering of nucleons from C^{12} are presented. From the two-nucleon amplitude, it is also possible to calculate the deviation of the mean square optical model radius from that of the charge distribution. A.E.I. Research Laboratory

539.12

6139. THEORETICAL ANGULAR DISTRIBUTION OF NUCLEON—ANTINUCLEON SCATTERING AT 140 MeV. J.R.Fulco.
Phys. Rev., Vol. 110, No. 3, 784-5 (May 1, 1958).

Using the transmission coefficients and phase shifts of Ball and Chew (Abstr. 1843/1958), the angular distributions are calculated for elastic and charge-exchange scattering. "Mixing" effects between different l-states are neglected. The elastic scattering shows strong forward peaking, in agreement with the few observations to date. P.K.Kabir

539.12

6140. DIFFRACTION SCATTERING AND NUCLEON STRUCTURE. S.Z.Belen'kii.
Zh. éksper. teor. Fiz., Vol. 33, No. 5(11), 1248-50 (1957). In Russian.

Scattering of high-energy particles is considered for the collision of two nucleons and for the collision of a π-meson with a nucleon. It is shown that at high energies each of these processes is characterized by a single scattering amplitude. An essential role is played only by the imaginary part of such an amplitude, which, generally speaking, may be determined from experiments on diffraction scattering. A.

539.12 : 539.17

POLARIZATION OF NUCLEONS ELASTICALLY SCATTERED BY NUCLEI. See Abstr. 5354

539.12

6141. ON THE QUESTION OF THE STRUCTURE OF THE PROTON. B.B.Dotsenko.
Dokl. Akad. Nauk SSSR, Vol. 119, No. 3, 466-8 (1958). In Russian.

An exponential trial function and adjustable parameters are postulated for the structure of the proton and substituted in the scattering equations. Conditions on the "structure" parameters can then be formulated in order that the calculated cross-sections agree with experiment. J.W.Gardner

539.12 : 537.572

K-SHELL IONIZATION BY PROTONS. See Abstr. 6007

539.12

6142. $\bar{p}$-p ELASTIC AND CHARGE EXCHANGE SCATTERING AT ABOUT 120 MeV. L.Agnew, T.Elioff, W.B.Fowler, L.Gilley, R.Lander, L.Oswald, W.Powell, E.Segrè, H.Steiner, H.White, C.Wiegand and T.Ypsilantis.
Phys. Rev., Vol. 110, No. 4, 994-5 (May 15, 1958).

Preliminary results are given from a propane bubble chamber experiment. 478 antiprotons were seen to undergo 33 elastic scatterings in 179 m of track, giving a total cross-section for elastic scattering between 15° and 165° (centre of mass) of 47^{+10}_{-7} millibarns. The angular distribution is given. G.H.Burkhardt

539.12

6143. PROTON—PROTON SCATTERING AT 40 MeV. L.H.Johnston and D.A.Swenson.
Phys. Rev., Vol. 111, No. 1, 212-22 (July 1, 1958).

Differential cross-sections were measured for the scattering of 39.4 MeV protons by hydrogen gas at angles from 45° to 4° in the laboratory system, with $\pm \frac{1}{2}°$ angular resolution at small angles. Data are given for every half degree near the interference minimum. The relative and absolute probable errors given are respectively ± 0.5% and ± 0.8% from 45° to 8°. The corresponding probable errors at 4° are ± 4.0% and ± 4.1%. The cross-section curve is essentially flat at 11.15 millibarns from 90° to 55° in the centre-of-mass system. It falls to a minimum of 9.80 millibarns at 21°, and rises rapidly to 104 millibarns at 8°. A typical but not unique set of phase shifts which fit the data is: $^1S_0$, 40°; $^3P_0$, 16.90°; $^1P_1$, −6.93°; $^3P_1$, 3.04°; $^1D_2$, 2.16°; coupling parameter between $^3P_2$ and $^3F_2$ as defined by Stapp, −2.21°. A.

539.12

6144. ANALYSIS OF 40 MeV p—p SCATTERING. H.P.Noyes and M.H.MacGregor.
Phys. Rev., Vol. 111, No. 1, 223-7 (July 1, 1958).

Analysis of the scattering data of the preceding abstract shows that

either the singlet proton—proton interaction gives an anomalously large D wave and an anomalously small S wave at 40 MeV, or that angular momentum states in addition to S, P, and D are present. The anomalously small S-wave fits to the data are always accompanied by large polarizations unless F waves are present as well. Hence, recent experimental measurements at Harvard, which show that the p—p polarization at 40 MeV is small, rule out the possibility of fitting the data with only S, P, and D waves. A.

539.12

6145. ON THE BACKWARD ELASTIC SCATTERING OF 660 MeV PROTONS ON CARBON NUCLEI. G.A.Leksin and Yu.P.Kumekin.
Zh. éksper. teor. Fiz., Vol. 33, No. 5(11), 1147-9 (1957). In Russian.

It is shown that the cross-section of elastic scattering backwards of 660 MeV protons on a carbon nucleus as a whole does not exceed 3×10^{-33} cm^2/sterad. The mechanism of ejection of fast fragments from nuclei, when the latter interact with high-energy nucleons, is discussed. A.

539.12 : 539.17

SCATTERING OF PROTONS AT INTERMEDIATE ENERGIES. See Abstr. 5348

539.12 : 539.17

POLARIZATION OF PROTONS FROM THE $C^{12}(d,p)C^{13}$ REACTION. See Abstr. 5361

539.12 : 539.17

PRODUCTION OF PROTON—ANTIPROTON PAIRS BY HIGH ENERGY γ-QUANTA. See Abstr. 5381

539.12

6146. POLARIZATION IN THE ELASTIC SCATTERING OF 2-3 MeV NEUTRONS BY DEUTERONS.
R.E.White, A.Chisholm and D.Brown.
Nuclear Phys., Vol. 7, No. 3, 233-6 (June [3], 1958).

Large polarization effects were observed in the elastic scattering of polarized neutrons from the D—D reaction by deuterons. The polarization for 90° centre-of-mass scattering is 0.58 ± 0.05 at 2.26 MeV and 0.86 ± 0.19 at 3.1 MeV and was measured by studying the asymmetry in the distribution of recoil deuterons in deuterium-filled proportional counters. A.

539.12 : 539.2

6147. ON THE SCATTERING OF SLOW NEUTRONS BY KCl.
A.Sjölander.
Ark. Fys., Vol. 13, No. 3, Paper 17, 199-214 (1958).

Numerical calculations of the coherent and incoherent one-phonon scattering of slow neutrons by a single KCl crystal are presented. The one-phonon scattering surfaces for a series of neutron energies and some different crystal settings were determined on the basis of the eigenfrequencies obtained by Tenerz when using a realistic model of KCl. Rough estimates of the scattering intensities were also made. A.

539.12 : 539.14

NEUTRON SCATTERING ON NUCLEI. See Abstr. 5256

539.12 : 539.14

NUCLEAR RADII BY SCATTERING OF LOW-ENERGY NEUTRONS. See Abstr. 5272

539.12 : 539.2

6148. ON TWO-PHONON PROCESSES IN NEUTRON DIFFRACTION AGAINST CRYSTALS. A.Sjölander.
Ark. Fys., Vol. 13, No. 3, Paper 18, 215-28 (1958).

The two-phonon processes in slow neutron scattering against single crystals are discussed. It is shown that in the harmonic approximation the energy distribution of neutrons scattered coherently in a certain direction has, in some cases, logarithmic singularities for the energies obtained in the one-phonon processes. Further, there appear singularities of the same kind as Van Hove found earlier for the incoherent one-phonon scattering. To illustrate the logarithmic singularities, more explicit results are given for an ideal Debye crystal. A formula for the incoherent two-phonon scattering is also given, and this is applied to KCl. A.

539.12

6149. RESONANCE ABSORPTION OF NEUTRONS BY THORIUM CYLINDERS. M.V.Davis.
J. appl. Phys., Vol. 28, No. 6, 714-16 (June, 1957).

The integrated effective resonance neutron absorption cross-section of Th^{232} cylinders was experimentally investigated by danger coefficient measurements in the Hanford Test Pile. The results were interpreted to yield the effective resonance integral as a function of the surface-to-mass ratio of the thorium cylinders. The experiments were extended to determine the Doppler coefficients resulting from heating the thorium in a constant neutron energy spectrum in the reactor. After correction for 1/v neutron absorption, the effective resonance integral can be approximated as a function of the surface-to-mass ratio by

$$\int (\sigma_{a0})_{eff} \frac{dE'}{E'} = 6.11 \left[1 + 5.0 \frac{S}{M} (1 - 0.87) \frac{S}{M} \right]$$

The value assigned to the Doppler coefficient of the volume absorption of the effective resonance integral is

$$\frac{1}{A} \frac{\partial A}{\partial T} = (2.3 \pm 0.2)\ 10^{-4}/\text{deg C}.$$

The results are compared to similar measurements on uranium. A.

539.12 : 539.17

EFFECTIVE CADMIUM CUTOFF ENERGY. See Abstr. 5409

539.12

6150. POLARIZATION OF NEUTRONS SCATTERED BY INTERMEDIATE AND HEAVY NUCLEI.
J.D.Clement, F.Boreli, S.E.Darden, W.Haeberli and H.R.Striebel.
Nuclear Phys., Vol. 6, No. 2, 177-87 (March [3], 1958).

Measurements of the polarization produced in the scattering of neutrons from heavy nuclei have been carried out at neutron energies of 380 keV and 980 keV. The $Li^7(p,n)Be^7$ reaction was used as a source of polarized neutrons. Right—left asymmetries in scattering of these neutrons from several elements ranging in atomic weight from 55 to 238 were measured at scattering angles of 55°, 90° and 130°. With few exceptions the observed polarizations vary smoothly with atomic weight. Measured values of the polarization range from −0.10 to +0.15 at 380 keV, and from −0.17 to +0.20 at 980 keV. The results at 380 keV neutron energy are compared with values predicted by the complex square well potential modified by a surface spin—orbit interaction. Using several sets of well parameters it was not possible to reproduce the experimental results. A.

539.12 : 539.17

6151. POLARIZATION MEASUREMENTS ON D + D AND T + D NEUTRONS GENERATED BY LOW ENERGY DEUTERONS.
P.J.Pasma.
Nuclear Phys., Vol. 6, No. 2, 141-50 (March [3], 1958).

The polarization of D + D and T + D neutrons was determined from the left-right asymmetry induced by elastic scattering through ^{4}He. A gas scintillator with helium served as the scatterer. The scattered neutrons were detected in coincidence with the helium recoil nuclei. The D + D neutron polarization was found to increase from 6% at 200 keV to about 9.5% at 500 keV deuteron bombarding energy. Neutrons from the T + D reaction appeared to be nearly unpolarized for deuteron energies below 300 keV. A.

539.12

6152. ABSOLUTE DETERMINATION OF MONOENERGETIC NEUTRON FLUX IN THE ENERGY RANGE 1 TO 30 MeV.
S.J.Bame, Jr, E.Haddad, J.E.Perry, Jr and R.K.Smith.
Rev. sci. Instrum., Vol. 28, No. 12, 997-1006 (Dec., 1957).

Monoenergetic neutron fluxes can be measured at neutron energies above 1 MeV by observing recoil protons scattered at forward angles from a hydrogenous radiator. A counter telescope system for observing the recoil protons is described which has a relatively high efficiency for neutron detection. The major part of the paper is devoted to backgrounds and corrections, the calculation of telescope efficiency, and the accuracy of neutron flux measurements. Tables are given which make possible a simple determination of the efficiency of a counter system at neutron energies between 1 and 30 MeV. An appendix presents a semiempirical formulation of n—p scattering which is used in obtaining counter efficiencies. A.

539.12 : 539.16

NEUTRON EMISSION BY EXCITED RaD NUCLEI. See Abstr. 5292

539.12 : 539.17

NEUTRON SPECTRA EMITTED FROM THE (n,2n) REACTION. See Abstr. 5382

539.12 : 539.17

DELAYED NEUTRONS FROM FISSIONABLE ISOTOPES OF URANIUM, PLUTONIUM, AND THORIUM. See Abstr. 5399

539.12

6153. NOTES ON MESON DECAYS. R.F.Streater and J.C.Taylor.
Nuclear Phys., Vol. 7, No. 3, 276-80 (June [3], 1958).

Some meson decay rates are examined as closely as possible, particularly to see if they are consistent with a universal Fermi interaction of V and A type. A possible connection is noted between the pion lifetime and the bare pion mass. A.

539.12

6154. THE ENERGY DEPENDENCE OF MESON MULTIPLICITY IN THE HIGH-ENERGY INTERACTIONS. S.Kaneko and M.Okazaki.
Nuovo Cimento, Vol. 8, No. 4, 521-32 (May 16, 1958).

An attempt is made to analyse some experimental data of high-energy showers so far reported. It is shown that the dependence of the meson multiplicity on the primary energy seems to be explained phenomenologically, at least within the present limitation of experimental accuracy, in terms of the single nucleon—nucleon collision by making allowance for the fluctuation in inelasticity. The result seems to be consistent with the assumption that the average energy of produced mesons in the centre-of-mass system is fairly constant (about 200 MeV kinetic energy) independently of the primary energy at least up to about 100 GeV (in the laboratory system), so that the meson multiplicity normalized at the value 1 of inelasticity increases rather sharply with the primary energy. At higher energies, the collimation of high-energy mesons into the forward and backward cones would result in increasing the average meson energy so that the increase of the normalized multiplicity with the primary energy seems to become slower than at lower energies. The results of the analysis are discussed in comparison with the existing theories of multiple meson production. A.

539.12 : 530.145

MESON—NUCLEON SCATTERING. See Abstr. 5651

539.12

6155. CROSS-SECTIONS FOR DOUBLE AND TRIPLE MESON PRODUCTION IN HYDROGEN BY PHOTONS WITH ENERGIES UP TO 1 BeV. J.M.Sellen, G.Cocconi, V.T.Cocconi and E.L.Hart.
Phys. Rev., Vol. 110, No. 3, 779-80 (May 1, 1958).

Three-prong events formed by photons in a hydrogen-filled diffusion cloud chamber were classed as either $p + \pi^+ + \pi^-$ (90 cases), $p + \pi^+ + \pi^- + \pi^0$ (3 cases) on $n + \pi^+ + \pi^+ + \pi^-$ (1 case). The energy spectrum and intensity of the photon beam was determined by examining the electron pairs in the chamber; it had a maximum energy of 1.05 BeV. For the first process the cross-section rises steeply from threshold at 320 MeV to a max. value of 80 microbarns at 600 MeV. The triple production processes appear to have a cross-section of about 10 microbarns at 1 BeV. The dependence of the double-production cross-section on energy suggests that this process, like that of single meson production, may be dominated by an excited state of the nucleon.

S.J.Goldsack

539.12 : 539.17

PHOTOPRODUCTION OF MESONS ON NUCLEONS: PHASE SHIFT ANALYSIS AND DISPERSION RELATIONS. See Abstr. 5372

539.12

6156. NOTE ON THE PROPERTIES OF THE μ-MESON.
S.Hirokawa and H.Komori.
Nuovo Cimento, Vol. 7, No. 1, 114-15 (Jan. 1, 1958).

Earlier work (Abstr. 8402/1956) is continued, and the possibility of spin - $3/2$ for the μ-meson is excluded. S.J.Goldsack

539.12

6157. THE INNER BREMSSTRAHLUNG OF A POLARIZED μ-MESON AND THE NON-CONSERVATION OF PARITY.
I.G.Ivanter.
Zh. éksper. teor. Fiz., Vol. 33, No. 6(12), 1383-6 (1957). In Russian.

Under the assumption of the combined parity conservation, formulae are derived for the angular and energy distributions of the inner bremsstrahlung accompanying the disintegration of a polarized μ-meson. A.

539.12

6158. SCATTERING OF μ^- MESONS BY NUCLEI.
J.Franklin and B.Margolis.
Phys. Rev., Vol. 109, No. 2, 525-8 (Jan. 15, 1958).

The effect of finite nuclear size on the scattering of μ^- mesons is calculated for a nucleus $Z = 80$, $R = 1.2\ A^{1/3} \times 10^{-13}$ cm. The nucleus is considered as a uniformly charged sphere. The μ^- mesons have $v/c = 0.2$ corresponding to an energy $E = 2.1$ MeV. It is found that the left—right asymmetry in the scattering of polarized μ^- mesons is decreased from that for a point nucleus. However, considerable asymmetry remains at large angles. A.

539.12

6159. SCATTERING OF μ^- MESONS BY NUCLEI.
J.Franklin, B.Margolis and H.Oberthal.
Phys. Rev., Vol. 111, No. 1, 296-7 (July 1, 1958).

See preceding abstract. Hand calculations have been extended by using an I.B.M.-650 Computer, to include energies corresponding to $v/c = 0.2$ ($E = 2.1$ MeV) and 0.4 ($E = 9.6$ MeV) for the nuclei $Z = 48$ and 80, the nucleus being considered as a uniformly charged sphere of radius $R = 1.2\ A^{1/3} \times 10^{-13}$ cm. A.

539.12

6160. VIRTUAL PION EFFECTS IN μ-MESON CAPTURE.
L.Wolfenstein.
Nuovo Cimento, Vol. 8, No. 6, 882-7 (June 16, 1958).

The μ-meson capture process contains an effective pseudoscalar interaction not present in the corresponding electron processes due to the decay of a single virtual pion emitted by the nucleon. The effect of this interaction on various possible observations is calculated for μ-meson capture in hydrogen and shown to be as large as 25%. A.

539.12

6161. ELECTROMAGNETIC PROPERTIES OF π-MESON.
L.Bertocchi and A.Minguzzi.
Nuovo Cimento, Vol. 8, No. 5, 783-6 (June 1, 1958).

The total electromagnetic charge—current operator taken between physical meson states is expressed in the most general manner following the method of Foldy (Abstr. 7947/1952) for the Dirac particle. It involves only one invariant function. P.K.Kabir

539.12

6162. A SUGGESTION ON THE THEORY OF THE $\pi \to e + \nu$ TO $\pi \to \mu + \nu$ RATIO. R.Gatto and M.Ruderman.
Nuovo Cimento, Vol. 8, No. 5, 775-7 (June 1, 1958).

It is shown that the ratio of the masses, appearing in the predicted relative rate of these two processes for A interaction, is the ratio of the bare masses. It is then suggested that the rarity of the electron mode may be accounted for by taking the ratio of the bare electron mass to the bare muon mass much smaller than the ratio of the physical masses. [The first result appears to be included in a result of Arnous and Heitler, which states that the physical masses are proportional to the bare masses; then the second assumption is not permitted.] P.K.Kabir

539.12

6163. INVESTIGATION OF ASYMMETRY OF $\pi^+ \to \mu^+ \to e^+$ DECAYS IN PHOTOGRAPHIC EMULSIONS.
A.O.Weissenberg and V.A.Smirnitsky.
Nuclear Phys., Vol. 5, No. 1, 33-40 (Jan., 1958).

The energy dependence of the angular distribution of positrons relative to the direction of emission of μ^+-mesons produced in $\pi^+ \to \mu^+ \to e^+$ decays is studied in photographic emulsions. A.

539.12 : 539.165.2 : 530.145

CONSERVATION OF LEPTON NUMBER IN PION DECAY. See Abstr. 5622

539.12

6164. DECAY INTERACTION OF THE PI-MESON.
S.Kamefuchi and S.Oneda.
Nuclear Phys., Vol. 6, No. 1, 114-24 (March [2], 1958).

It is pointed out that the question of the elementarity of the decay interaction of the π-meson could be settled by considering its radiative decay. For this purpose, the energy spectrum and the angular correlation function of daughter particles are calculated without using any approximation for strong interactions. These functions also serve to determine the concrete form of the decay interaction. A.

539.12

6165. RADIATIVE BETA DECAY OF THE PION.
G.H.Burkhardt, J.M.Cassels, M.Rigby, A.M.Wetherell and J.R.Wormald.
Proc. Phys. Soc., Vol. 72, Pt 1, 144-7 (July, 1958).

Experimentally, less than 1 pion in 10^8 decays by the process $\pi^+ \to e^+ + \nu + \gamma$. This is consistent with a nuclear beta-decay interaction that does not include an appreciable tensor component.

J.M.Cassels

539.12

6166. INTERACTION OF SLOW π-MESONS WITH NUCLEI.
A.M.Baldin and A.I.Lebedev.
Zh. éksper. teor. Fiz., Vol. 33, No. 5(11), 1221-6 (1957). In Russian.

The effect of the interaction of charged mesons with a nucleus on the cross-section of production of mesons on nuclei for the case when the meson wavelength exceeds the size of the nucleus is considered.

A relation is obtained relating the cross-section of photoproduction of mesons with the shifts and widths of mesoatomic levels. A comparison with experimental data permits of a number of conclusions concerning the interaction of mesons with groups of nucleons and the mechanism of the photoproduction of mesons on nuclei. A.

539.12

6167. ON THE ELASTIC SCATTERING OF PIONS BY DEUTERONS. B.H.Bransden and R.G.Moorhouse.
Nuclear Phys., Vol. 6, No. 2, 310-18 (March [3], 1958).

The elastic scattering of pions by deuterons is calculated for incident pion energies from 85 to 378 MeV. A variational method is employed which includes the effects of multiple scattering. Satisfactory agreement is obtained with experiment. For the pion—deuteron system the multiple scattering corrections turn out to be small but it is suggested that the method presented may be particularly suitable for future applications when multiple scattering effects are not small. A.

539.12

6168. PHOTOPRODUCTION OF π^--MESONS NEAR THRESHOLD AND THE VALUE OF THE PANOFSKY RATIO. A.Baldin.
Nuovo Cimento, Vol. 8, No. 4, 569-83 (May 16, 1958).

An examination of the cross-sections for the reactions

$$\gamma + d \rightarrow \begin{cases} 2n + \pi^+ \\ 2p + \pi^- \end{cases}$$

near threshold was performed. The comparison of the results of this examination with experiment is presented, and it is shown that the negative to positive ratio is constant in the photon energy range (153-193) MeV and equal to 1.4 (to an accuracy of 10%) in agreement with field theory results. The disagreement of these results with the values of the Panofsky ratio and the S-wave scattering phase-shifts is discussed from the point of view of the two-component π^0-meson field hypothesis. A direct experimental test of this hypothesis is proposed. A.

539.12

6169. PION MULTIPLICITY IN ANTINUCLEON ANNIHILATION. E.Eberle.
Nuovo Cimento, Vol. 8, No. 4, 610-14 (May 16, 1958).

Pion multiplicity in antinucleon annihilation is calculated using Dyson's hypothesis of pion—pion resonance interaction. The percentage of K-mesons is also evaluated supposing that their volume of interaction has a radius given by the Compton wavelength of K-mesons. Results are in reasonable agreement with experimental data. A.

539.12

6170. PION—PION INTERACTION AND MULTIPLE PION PRODUCTION IN NUCLEON—ANTINUCLEON ANNIHILATION PROCESS. T.Gotô.
Nuovo Cimento, Vol. 8, No. 5, 625-31 (June 1, 1958).

The multiple pion production in antinucleon—nucleon annihilation processes is investigated by means of statistical theory with strong pion—pion interaction. The characteristics of the isobar state of two pions are determined from the observed momentum distribution of a nucleon in the reaction $\pi^- + p \rightarrow N + 2\pi$ at 1 GeV or from the theories of Takeda, Dyson and Miyazawa. The mean number of pions produced is 3 to 4, rather less than that given by experiment. A.

539.12

6171. HIGH-ENERGY PHOTOPRODUCTION OF π^0 MESONS FROM HYDROGEN. J.W.DeWire, H.E.Jackson and R.Littauer.
Phys. Rev., Vol. 110, No. 5, 1208-9 (June 1, 1958).

Cross-sections for the reaction $\gamma + p \rightarrow p + \pi^0$ were measured at three angles in the energy range $300 < E_\gamma < 1000$ MeV. An excited state of the proton is suggested. J.M.Cassels

539.12

6172. PHOTOPRODUCTION OF π^0 MESONS FROM HYDROGEN AT 500-900 MeV. P.C.Stein and K.C.Rogers.
Phys. Rev., Vol. 110, No. 5, 1209-11 (June 1, 1958).

The cross-section for the reaction $\gamma + p \rightarrow p + \pi^0$ was studied at three angles. J.M.Cassels

539.12

6173. PHOTOPRODUCTION OF π^+ MESONS FROM HYDROGEN IN THE REGION 350-900 MeV. M.Heinberg, W.M.McClelland, F.Turkot, W.M.Woodward, R.R.Wilson and D.M.Zipoy.
Phys. Rev., Vol. 110, No. 5, 1211-12 (June 1, 1958).

The cross-section for the reaction $\gamma + p \rightarrow n + \pi^+$ was studied at three angles. The results show a peak at $E_\gamma = 650$ MeV, which suggests the existence of a hitherto unobserved resonance in the pion—nucleon interaction. J.M.Cassels

539.12

6174. DISPERSION THEORY TREATMENT OF PION PRODUCTION IN ELECTRON—NUCLEON COLLISIONS. S.Fubini, Y.Nambu and V.Wataghin.
Phys. Rev., Vol. 111, No. 1, 329-36 (July 1, 1958).

The production of mesons in electron—nucleon collisions is treated by using the method of dispersion relations. The result is analogous to that obtained by Chew, Low, Goldberger, and Nambu for photoproduction using the same method Apart from the appearance of longitudinal and scalar components of the virtual photon polarization, the important difference is that charge and magnetic moments have to be multiplied by the appropriate nucleon electromagnetic form factors. Two formulae are given for the scattering amplitude: one is a static approximation which is valid if the electron invariant momentum transfer λ is less than 500 MeV; the other takes account of the recoil effects, and may be trusted within 30% even up to $\lambda \sim 1$ BeV. It is suggested that the measurement of the energy and angular distribution of the electron can offer an alternative method for the determination of the nucleon form factors. A.

539.12

6175. A FURTHER EXAMPLE OF AN ANOMALOUS K^+-DECAY. D.J.Prowse and D.Evans.
Nuovo Cimento, Vol. 8, No. 6, 856-60 (June 16, 1958).

In a systematic study of K^+-meson secondaries, one example was found in which the charged product was a π-meson of 61.7 MeV. This must be compared with the example published by the Columbia group in which the π-meson energy was 60 MeV. Both are probably due to the decay mode: $K^+ \rightarrow \pi^+ + \pi^0 + \gamma$ although the possibility that they belong to a two body decay mode: $K^+ \rightarrow \pi^+ + X^0$, where X^0 is a neutral boson and has a mass of (500 ± 5) m , should not be overlooked. A description of the event is given and the interpretation discussed. A.

539.12

6176. ISOTOPIC PROPERTIES OF THE K-MESON DECAY INTERACTION. R.F.Sawyer.
Nuovo Cimento, Vol. 8, No. 2, 350-1 (April 16, 1958).

Some possible symmetries are suggested to explain the K_1^0 decay mode, $6\tau/\tau'$ branching ratios, and the long K^+ lifetime. G.H.Burkhardt

539.12

6177. INTERACTIONS AND DECAYS OF K^- MESONS. II. ANALYSIS OF THE DECAYS. Y.Eisenberg, W.Koch, E.Lohrmann, M.Nikolić, M.Schneeberger and H.Winzeler.
Nuovo Cimento, Vol. 8, No. 5, 663-70 (June 1, 1958).

For previous part see Abstr. 1199/1958. In a systematic study of about 1600 K^--mesons in nuclear emulsions, two τ^- and 50 events were observed where the primary K^- disappears in flight, giving rise to nothing but one "light track". Twelve of these events had an associated blob at the K^- disappearance point and 38 had no such an associated blob. It is shown that most of the 38 events without an associated blob are examples of K^- decay in flight. Detailed analysis of these events gives the following results: (a) The $K_{\mu 2}^-$ and the $K_{\pi 2}^-$ decay modes should be considered as established. The mean c.m.s. kinetic energies of the secondaries observed were: $K_{\mu 2}$, $T_\mu^{CM} = (153 \pm 4)$ MeV; $K_{\pi 2}$, $T_\pi^{CM} = (109.5 \pm 3)$ MeV. (b) The relative abundance of the $K_{\mu 2}$ is about 50%. (c) The mean K^- lifetime is $\tau_{K^-} = (1.60 \pm 0.3) \times 10^{-8}$ sec. A.

539.12

6178. POLARIZATION OF μ-MESONS AND ELECTRONS IN K-MESON DECAYS: A CORRECTION. J.Werle.
Nuclear Phys., Vol. 4, No. 5, 693 (Nov., 1957).

Two errors in an earlier paper (Abstr. 4244/1958) are corrected. One relates to the choice of helicity for the neutrino, leading to a reversal of sign for certain polarization curves; the other to a neglect of certain interference terms which may be present, even if CI invariance holds. P.K.Kabir

539.12

6179. DEPENDENCE OF μ-MESON AND ELECTRON POLARIZATION ON CORRELATION PARAMETERS IN $K_{\mu s}$ AND K_{es} DECAYS. J.Werle.
Nuclear Phys., Vol. 6, No. 1, 1-9 (March [2], 1958).

The polarization of the μ-mesons and electrons emitted in $K_{\mu s}$ and K_{es} decays is investigated on the basis of the two-component theory of the neutrino field. A quite general form of the transition matrix is used under the only assumption that the corresponding

K-mesons have no spin. It is shown that for pure couplings the form of the functional dependence of the polarization vector on the correlation parameters E and θ is uniquely determined by the type of coupling and does not involve the unknown coupling factors $C_i(E,\theta)$. A combined correlation and polarization experiment can, therefore, provide the best tool for the investigation of the actual form of the coupling responsible for the $K_{\mu 3}$ and K_{e3} decays. A.

539.12

6180. EVIDENCE AGAINST THE REACTION $K^+ \rightarrow \mu^+ + \mu^0$. V.P.Henri and A.M.Shapiro.
Phys. Rev., Vol. 110, No. 2, 591-3 (April 15, 1958).

Marshak and Sudarshan (Abstr. 1177/1958) have remarked that if a neutral muon exists, it would be most evident from the decay reaction of the title, which can be easily distinguished from the normal K^+ decay mode by the difference of about 11 MeV in the kinetic energies of the charged muons in the two reactions, assuming the μ^0 to have the same mass as the other muons. The published material on K_μ^+ decays is examined and no evidence found of such a group of lower energy positive muons. The possibility of a neutral muon with a mass of half the charged muon mass or less cannot be excluded, but there is no reason to postulate such a particle at this time. P.K.Kabir

539.12

6181. LIFETIME AND DECAY OF THE K_2^0 MESON. M.Bardon, M.Fuchs, K.Lande, L.M.Lederman, W.Chinowsky and J.Tinlot.
Phys. Rev., Vol. 110, No. 3, 780-2 (May 1, 1958).

Events interpreted as decays of K_2^0-particles were examined in a diffusion cloud chamber exposed at 16 ft and 70 ft from a copper target irradiated with 3 BeV protons. On each occasion neutral particles emitted from the target at 68° were observed. From the two runs a mean life for the K_2^0 particle of $(9.0^{+3.5}_{-2.5}) \times 10^{-8}$ sec was deduced. This agrees with an estimate $\sim 5 \times 10^{-8}$ sec obtained from consideration of the K^+ decay modes and the $\Delta T = \frac{1}{2}$ rule. No decays were found that were not consistent with one of the modes $(\pi^\pm, \mu^\mp, \nu)$, $(\pi^\pm, e^\mp, \nu)$ or (π^+, π^-, π^0), as expected on the basis of CP invariance. S.J.Goldsack

539.12

6182. ELASTIC AND INELASTIC SCATTERING OF K^+-PARTICLES IN NUCLEAR EMULSIONS. K.Kristiansson.
Ark. Fys., Vol. 13, Paper 8, 91-100 (1957).

The frequency of elastic and inelastic K^+-particle scattering and the energy loss in inelastic scattering were studied at a K-particle energy of 80-120 MeV. 32.5 m K-particle track was followed. The frequency of elastic scatterings in the angular interval 12°-20° indicates a repulsive nuclear potential of about 10 MeV if the optical nuclear model is used. The mean free path for inelastic scattering (including charge-exchange events) is equal to 1.12 ± 0.23 m, corresponding to a total cross-section of 181 ± 37 millibarns. One $K^+ + P$-collision was found. The scattering angle for the K^+-particle is 57° in the centre-of-mass system. A.

539.12

6183. TIME-REVERSAL INVARIANCE AND θ_2^0 DECAY. S.Weinberg.
Phys. Rev., Vol. 110, No. 3, 782-4 (May 1, 1958).

The observation that $\theta_2^0 \rightarrow \pi^+ + \pi^-$ occurs infrequently (see preceding abstract) supports the assumption of CP invariance; for it can only be explained otherwise by a chance equality of the phases for $K^0 \rightarrow \pi + + \pi^-$ and $K^0 \rightarrow 2\pi^0$. Another consequence of this observation is that little charge asymmetry in θ_2^0 decay is to be expected, irrespective of whether CP is conserved or not. J.C.Taylor

539.12

6184. ON THE SPINS AND DECAY INTERACTIONS OF $K_{\mu 3}$ AND K_{e3}. S.Furuichi, T.Kodama, S.Ogawa, Y.Sugahara, A.Wakasa and M.Yonezawa.
Progr. theor. Phys., Vol. 17, No. 1, 89-106 (Jan., 1957).

The decay events $K_{\mu 3}$ and K_{e3} are investigated using the Lorentz invariance requirements as the restriction for the transition matrix, assuming that weak Fermi interactions are participating in the decays. The Fermi interaction concerned is that realized among $\Lambda(\Sigma)$, N, μ(e) and ν. The study of the experimental data in the light of this analysis shows that the K_{e3} seems to have spin 0 and the tensor type of Fermi interaction is necessary, while for the $K_{\mu 3}$ no definite conclusion can be made. A.

539.12

6185. INTERACTION OF THE FERMIONS IN $K_{\mu 3}$ DECAY. S.G.Matinyan.
Zh. éksper. teor. Fiz., Vol. 33, No. 3(9), 797-9 (1957). In Russian.

Calculation of the energy spectrum of muons from $K_{\mu 3}$ decay. Analysis of the results is more difficult than in the case of the K_{e3} decay, because the muon mass cannot be neglected. J.W.G.Wignall

539.12

6186. STUDY OF τ^+-MESON DECAY IN A PROPANE BUBBLE CHAMBER. T.F.Zipf and M.L.Perl.
Nuovo Cimento, Vol. 8, No. 4, 622-3 (May 16, 1958).

A Dalitz—Fabri analysis of the data from 136 τ^+-mesons decaying at rest supported the 0^- spin—parity combination. E.J.Burge

539.12

6187. METHOD FOR DETERMINING THE $\theta_1 - \theta_2$ MASS DIFFERENCE. W.F.Fry and R.G.Sachs.
Phys. Rev., Vol. 109, No. 6, 2212-13 (March 15, 1958).

The method discussed is to measure the time dependence of the relative θ and $\bar{\theta}$ intensities in a beam by observing its interactions with matter. J.C.Taylor

539.12 : 539.14

6188. SPINS AND PARITIES OF THE $_\Lambda H^4$ HYPERFRAGMENT AND K-MESON. Chou Kuang-Chao and M.I.Shirokov.
Nuclear Phys., Vol. 6, No. 1, 10-19 (March[2], 1958).

If K-mesons, hyperfragments or hyperons are created in the $\pi^- + He^4$ reaction near the threshold or in the $K^- + He^4$ reaction at low K^--particle energies (but without mesic atom formation), the spins of these unstable particles (and in some cases their parities) can be determined from the correlations between the direction of the momenta of the particles involved in these reactions and the directions of emission of decay products of the unstable particles. Qualitative changes in the correlation formulae for the cascade $K^- + He^4 \rightarrow {}_\Lambda H^4 + \pi^0$, ${}_\Lambda H^4 \rightarrow He^4 + \pi^-$ are indicated which arise if one rejects the assumption that the K-meson spin is zero. The helium experiments together with the previously suggested hydrogen experiments (e.g. $\pi^- + p \rightarrow \Sigma + K$ or $K^- + p \rightarrow \Sigma + \pi$) are the only ones which are of practical use for the determination of new particle spins from angular correlations. A.

539.12

6189. ON THE INTERACTION LAGRANGIAN OF K-MESONS AND HYPERONS. V.G.Solov'ev.
Zh. éksper. teor. Fiz., Vol. 33, No. 3(9), 796-7 (1957). In Russian.

Forms of the K-meson—pion and hyperon—nucleon interactions are presented that are invariant under the combined operation of parity and charge conjugation, but not invariant under these operations separately. The interactions conserve the third component of isotopic spin but not in general the isotopic spin itself. J.W.G.Wignall

539.12

6190. SCATTERING OF K^--MESONS ON COMPLEX NUCLEI. P.Mittelstaedt.
Nuclear Phys., Vol. 6, No. 1, 50-4 (March [2], 1958). In German.

The investigations of the K^--meson/nucleus scattering by means of the optical model have shown that the imaginary part of the optical potential is very large while the real part almost vanished. It is shown here that the vanishing of the real part of the optical potential results from the strong absorption of K^--mesons in the K^-—nucleon scattering process. A.

539.12

6191. ABSORPTION OF SLOW NEGATIVE KAONS IN HYDROGEN AND DEUTERIUM. A.Fujii and R.E.Marshak.
Nuovo Cimento, Vol. 8, No. 5, 643-62 (June 1, 1958).

The transition probabilities for the competing reactions resulting from the absorption of slow negative K-mesons in hydrogen and deuterium are calculated on the basis of a simple model. Computations are carried out for scalar and pseudoscalar coupling of the K-meson from the 1s and 2p orbitals of the appropriate K-mesic atom. The absorption from the 2p state is enhanced with respect to the pion case because of the smaller size of the orbit. This effect tends to reduce the possibility of distinguishing between the scalar and pseudoscalar character of the K-meson coupling in strong interactions. The emission of a single pion is favoured for deuterium as well as for hydrogen. Qualitative conclusions are drawn concerning the relative importance of the other modes of K-meson absorption in both hydrogen and deuterium. A.

539.12

6192. ON THE COUPLING BETWEEN (Λ^0, p) FIELD AND THE K-MESON FIELD. E.M.Ferreira.
Nuovo Cimento, Vol. 8, No. 2, 359-60 (April 16, 1958).

It is shown that the known $K_{\mu 2}$ decay interaction will make negligible contribution to the decay of Λ^0, unless the K-decay itself is strongly "forbidden". G.H.Burkhardt

539.12 : 530.145

6193. THE HYPERON DECAYS AND THE STRUCTURE OF INTERACTIONS. H.Umezawa, M.Konuma and K.Nakagawa.
Nuclear Phys., Vol. 7, No. 2, 169-83 (June [2], 1958).

Experiments have shown that, in cases of the weak fermion interactions and π-decay interaction, the coupling constant for the parity conserving term and that for the parity non-conserving term are almost equal to each other. Assuming that this is the situation in every case of weak interactions, it is shown that the Λ-decay interaction is of the derivative (vector and axial vector) coupling type. This belongs to the second kind of interactions, as do the weak fermion interactions. Various features which stem from the basic assumption that all the weak interactions violating the parity conservation belong to the second kind are discussed. A result which follows from this basic assumption is the universality of the coupling constants for the weak interactions. The two-neutrino decay of K is forbidden, as it should be. The situation for the processes, $\pi \rightarrow e + \nu$ and $\pi \rightarrow e + \nu + \gamma$ is much better than in the case of the weak interactions of the first kind. A dimensional analysis is used to obtain information on the strength of interactions in each energy region. It suggests that the weak interactions belonging to the second kind predominate over all the other interactions in the high-energy region corresponding to a scale $< 10^{-20}$ cm. The violation of the parity conservation may be due to some feature of space for small distances. It is suggested that multiple production of leptons may occur at extremely high energies. The high-energy behaviour of the strong interactions like the π-nucleon coupling is briefly discussed; the nucleon Compton wavelength may characterize a region where the strong interactions behave in a way different from ordinary notions. In this sense, various strata of nature may be met in high-energy regions. A.

539.12 : 539.14

6194. DERIVATION OF THE Λ^0–α POTENTIAL FROM THE $^5He_\Lambda$ AND $^9Be_\Lambda$ HYPERFRAGMENT BINDING ENERGIES.
H.Wilhelmsson and P.Zielinski.
Nuclear Phys., Vol. 6, No. 2, 219-21 (March [3], 1958).

Only the depth and range of the Λ^0–α potential are expected to be important. These are found from the binding energies of $He^5\Lambda$ and Be^9_Λ, treated as $\Lambda^0 + \alpha$ and $\Lambda^0 + \alpha + \alpha$ systems. A Gaussian Λ^0–α potential shape and a Coulomb α–α potential are assumed. R.J.N.Phillips

539.12

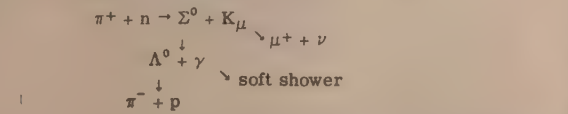
6195. ON THE Σ^- CAPTURE AND THE Λ-NUCLEON CROSS-SECTION. N.N.Biswas and M.Ceccarelli.
Nuovo Cimento, Vol. 8, No. 4, 599-606 (May 16, 1958).

An interpretation of the data on the capture of Σ^--particles by nuclei of photoemulsion is attempted on the basis of the independent particle model. In particular it is found that the probability of the Λ-particle produced in the capture to remain trapped in the nucleus, and hence the average size of the Σ^-capture star, strongly depends on the mean free path of Λ-particles in nuclear matter. In order to justify the experimental data the Λ–N elastic cross-section at energies around 50 MeV should be about 15 mb. A.

539.12

6196. ASSOCIATED PRODUCTION OF Σ^0 AND $K^+_{\mu 2}$.
M.S.Sinha and C.R.Mallik.
Nuovo Cimento, Vol. 8, No. 4, 549-54 (May 16, 1958).

Direct evidence for the associated production of a Σ^0 along with a $K^+_{\mu 2}$ has been obtained. The most interesting feature of the picture is that, besides showing the decays of a $\Lambda^0(\rightarrow \pi^- + p)$ and $K^+_\mu(\rightarrow \mu^+ + \nu)$ it shows the materialization of the photon resulting from $\Sigma^0 \rightarrow \Lambda^0 + \gamma$. The values of the energy of the emitted photon as derived from the decay dynamics and also from the energies of the soft electrons produced by it agree remarkably well. An overall energy balance is obtained for the whole event which is represented by the following reaction



A.

539.12

6197. ELECTROMAGNETIC PROPERTIES OF DEUTERON. II.
K.Itabashi.
Progr. theor. Phys., Vol. 17, No. 1, 80-8 (Jan., 1957).

The electric quadrupole moment of the deuteron is calculated by the formalism proposed in Pt I (Abstr. 3489/1956) and with the meson theoretical wave-function of the deuteron. The result obtained agrees with the experimental evidence within the inevitable ambiguity involved in present meson theory. The mesonic correction part of the quantity is found to be essentially due to the recoil effect, and therefore the calculated value is reliable only in a qualitative sense. However, the numerical calculation shows that this part amounts to only a few percent of the total value. This seems to be a further support to the discussions of Iwadare et al. on the applicability of the meson theory of the nuclear forces in the low energy region. A.

539.12 : 539.17

DEUTERON ABSORPTION CROSS-SECTION FOR HIGH-ENERGY PARTICLES. See Abstr. 5395

539.12 : 539.17

SCATTERING OF FAST DEUTERONS BY NUCLEI.
See Abstr. 5363

NUCLEUS

539.14

6198. NOTE ON EFFECTIVE RANGE THEORY. N.Austern.
Nuclear Phys., Vol. 7, No. 2, 195-201 (June [2], 1958).

It is shown that the basic formula of effective range theory may be derived from the orthogonality of wave-functions. The results of this theory therefore are not limited in their application to systems which can be described by a phenomenological Schrödinger equation. Some discussion is given of n–p scattering with tensor forces, of the Bethe–Longmire theory of deuteron photodisintegration, and of partial waves of angular momentum greater than zero. It is remarked that the Bethe–Longmire result for the electric dipole photodisintegration may be derived without any consideration of the nature of the neutron–proton interaction. A.

539.14

6199. DOUBLET SEPARATION IN NUCLEI FROM SIGNELL–MARSHAK POTENTIAL. B.P.Nigam and M.K.Sundaresan.
Phys. Rev., Vol. 111, No. 1, 284-5 (July 1, 1958).

The spin–orbit splittings for the $l = 1$ and $l = 3$ levels of Ca^{41} and $l = 2$ level of O^{17} are calculated in the spirit of Brueckner's theory of the first Born approximation from the spin–orbit term that Marshak and Signell (Abstr. 2468/1958) have added to the two-nucleon Gartenhaus potential. The results obtained are much larger than those obtained from the conventional tensor force in second order. A.

539.14 : 539.17

6200. FLUCTUATIONS OF THE NUCLEAR MATTER.
D.I.Blokhintsev.
Zh. éksper. teor. Fiz., Vol. 33, No. 5(11), 1295-9 (1957). In Russian.

It is shown that the production of energetic fragments in collisions of fast nucleons with nuclei can be considered to be a result of nucleon collisions with fluctuations of the nuclear matter. A.

539.14

6201. MOMENTUM DEPENDENCE OF THE NUCLEAR SHELL MODEL POTENTIAL. R.B.Hall and R.J.Eden.
Nuclear Phys., Vol. 6, No. 2, 157-60 (March [3], 1958).

The momentum dependence of the shell-model potential near the edge of the O^{16} nucleus was investigated by taking the average of an assumed form of pseudo-potential acting between pairs of nucleons. The reduced-mass approximation was used and the variation of m* is calculated as a function of nuclear density. A.

539.14

6202. CORE EFFECTS IN LIGHT NUCLEI. G.Barton.
Nuclear Phys., Vol. 6, No. 1, 100-1 (March [2], 1958).

Reports a shell-model calculation of core effects on the $2s_{1/2}$–$1d_{5/2}$ transition in F^{17}. These effects are nearly twice as large as for the same transition in the mirror nucleus O^{17}. Similar effects in the p-shell are discussed. R.J.N.Phillips

539.14

6203. CENTER-OF-MASS MOTION IN THE NUCLEAR SHELL MODEL. H.J.Lipkin.
Phys. Rev., Vol. 110, No. 6, 1395-7 (June 15, 1958).

The methods for treating centre-of-mass motion in the nuclear shell model are reviewed. The existence of inherent difficulties of

principle is pointed out for any method which attempts to remove centre-of-mass effects from a shell-model wave-function without considering the relation of the shell-model wave-function to the Hamiltonian of the real nucleus. A.

539.14

6204. RELATION BETWEEN THE NUCLEAR COLLECTIVE MODEL AND THE INDIVIDUAL PARTICLE MODEL WITH CONFIGURATIONAL MIXING. S.Hayakawa and T.Marumori.
Progr. theor. Phys., Vol. 17, No. 1, 43-62 (Jan., 1957).

By using the method of the quantum mechanical description of collective motion, the relation between the collective model and the individual particle model with configurational mixing is discussed on the basis of the following postulates: (I) The wave-function of the nucleus, as a system composed of actual nucleons, implies strong correlations, so that the Hartree approximation makes little sense. Consequently, the method of configurational mixing currently employed as well as the shell model may not be usable without altering the representation; (II) The strong correlation gives rise to collective motion, chiefly the surface oscillation at low energies. The individual motion of nucleons which remains after subtraction of the collective motion is only weakly correlated, so that the shell model is a good approximation to the individual motion. Leaving aside the essential problem of proving this statement, the following conclusions are reached concerning the relationship between the collective and the shell models of nuclei. (i) The individual particle model with configurational mixing does in fact hold in the case of small nuclear deformation, provided that the individual particle motion in the "collective representation" can be treated by means of the adiabatic approximation. (ii) The effective inter-particle force responsible for the configurational mixing consists of the following two parts, one arising from the exchange of surfons between an extra-particle and a particle in the core and the other arising from a direct inter-particle interaction. (iii) As far as the quadrupole moment is concerned, the collective model and the method of configurational mixing do not show any essential difference. However, there exists an essential difference in these two methods for the interpretation of magnetic moments. A.

539.14

6205. THE "CLUSTER MODEL" OF THE ATOMIC NUCLEI.
K.Wildermuth and T.Kanellopoulos.
Nuclear Phys., Vol. 7, No. 2, 150-62 (June [2], 1958).

A method is discussed which makes it possible to see that in nuclei many different cluster structures are present. Which cluster structures are preferred depends on the form and strength of the interaction forces, the type of nucleus and the excitation levels of this nucleus. Some examples are discussed. The influence on the asymmetrical fission is mentioned briefly. A.

539.14 : 539.12

SPIN—ORBIT COUPLING IN THE NEUTRON—PROTON INTERACTION. See Abstr. 6137

539.14

6206. CONFIGURATION MIXING IN THE C^{14} GROUND STATE.
E.Baranger and S.Meshkov.
Phys. Rev. Letters, Vol. 1, No. 1, 30-2 (July 1, 1958).

The results of $C^{14}(d,t)C^{13}$ experiments (Abstr. 6307/1958) are analysed to show that there is considerable configuration mixing in C^{14} and that it is sufficient to produce cancellation of the C^{14} to N^{14} beta-decay matrix element without invoking any tensor force.

L.L.Green

539.14 : 539.17

QUASI-ELASTIC SCATTERING AND NUCLEAR STRUCTURE. See Abstr. 5346

539.14 : 539.12

6207. APPROXIMATE OPTICAL MODEL EXPRESSIONS FOR THE ELASTIC SCATTERING AND POLARIZATION OF FAST PROTONS BY NUCLEI IN THE FORWARD SCATTERING PEAK. H.S.Köhler.
Nuclear Phys., Vol. 6, No. 2, 161-74 (March [3], 1958).

It is pointed out that in the forward peak the elastic differential cross-sections and polarization of fast protons or neutrons scattered from nuclei, when calculated from the usual nuclear optical model interaction, are not sensitive to the shape of the central well. On these grounds expressions were derived that should represent the scattering from any plausible well shape and with which it is practically possible to obtain optical model parameters by handmachine-calculation. The formulae may be of some guidance when electronic machine calculations are made. They are applied to a few cases. A.

539.14

6208. THE ELASTIC SCATTERING OF 30.5 MeV ALPHA-PARTICLES FROM Ni, Cu AND Au.
L.W.Swenson, U.Schindewolf and N.S.Wall.
Nuclear Phys., Vol. 6, No. 2, 203-9 (March [3], 1958).

The angular distributions of 30 MeV alpha-particles elastically scattered from Au, Cu, and Ni were measured and compared with pure Coulomb scattering. A sensitive comparison of the Cu and Ni data was made by comparing the ratio of Cu to Ni from experiment with that which would be expected if diffraction scattering were the only contributing process. An absence of a significant compound elastic contribution is concluded. A.

539.14

6209. ANGULAR DISTRIBUTION OF ELASTICALLY SCATTERED 14.7 MeV NEUTRONS. S.Berko, W.D.Whitehead and B.C.Groseclose
Nuclear Phys., Vol. 6, No. 2, 210-18 (March [3], 1958).

The differential elastic scattering cross-sections of 14.7 MeV neutrons were obtained for Mg, Al, Ni, Cu, Pb and Bi. The neutrons from the (d,t) reaction were scattered from cylindrical scatterers and were counted by a time-of-flight setup measuring $n-\alpha$ coincidences with 2.5×10^{-9} sec resolving time. The angular distributions thus obtained were compared with recent theoretical distributions from Livermore employing a potential which has a rounded real part, a surface imaginary part and a real spin—orbit coupling term. A.

539.14

6210. ELASTIC SCATTERING OF 24.6 MeV ALPHA PARTICLES BY Au. S.Igarasi and T.Takano.
Progr. theor. Phys., Vol. 17, No. 1, 124-6 (Jan., 1957).

The partial wave method is employed to calculate the elastic scattering, using the continuum theory for the interaction between the incident α and the Au nucleus. The diffraction oscillation of the Blair (Abstr. 10488/1954) model does not appear here, but the experimental large angle behaviour of the differential cross-section is not reproduced. It is suggested that this could be improved by using a complex potential with tail. J.Lascoux

539.14 : 539.17

HIGH ENERGY (p, 2p) REACTIONS AND PROTON BINDING ENERGIES. See Abstr. 5347

539.14

6211. SPINS OF INDIUM-109, INDIUM-110m, AND INDIUM-111.
L.L.Marino, W.B.Ewbank, W.A.Nierenberg, H.A.Shugart and H.B.Silsbee.
Phys. Rev., Vol. 111, No. 1, 286-7 (July 1, 1958).

The nuclear spins of three neutron-deficient radioactive isotopes of indium were measured by the use of the atomic-beam magnetic-resonance technique. Results are I = 9/2 for 4.3 hr In^{109}; I = 7 for 5.0 hr In^{110m}; and I = 9/2 for 2.8 day In^{111}. A.

539.14

6212. SPIN OF Ni^{61}. H.H.Woodbury and G.W.Ludwig.
Phys. Rev. Letters, Vol. 1, No. 1, 16-17 (July 1, 1958).

The electron spin resonance spectrum of Ni^{61}-doped germanium shows the spin of Ni^{61} to be 3/2. M.A.Grace

539.14 : 539.2

SPIN OF Mg^{25}. See Abstr. 5485

539.14

6213. NUCLEAR MAGNETIC RESONANCE OF MERCURY Hg^{201} ALIGNED BY OPTICAL PUMPING.
B.Cagnac, J.Brossel and A.Kastler.
C.R. Acad. Sci. (Paris), Vol. 246, No. 12, 1827-30 (March 24, 1958). In French.

The nuclear alignment of Hg^{201} was obtained by optical irradiation in a magnetic resonance experiment. Nuclear magnetic resonance was detected by optical means at 10 kc/s and 35.6 G.

R.W.Nicholls

539.14 : 538.222

6214. A DETERMINATION OF THE NUCLEAR MOMENTS OF Gd^{155} AND Gd^{157} FROM THE HYPERFINE STRUCTURE OF PARAMAGNETIC RESONANCE. A.A.Manenkov and A.M.Prokhorov.
Zh. éksper. teor. Fiz., Vol. 33, No. 5(11), 1116-18 (1957). In Russian

The nuclear spins ($^3/_2$) and the ratio of magnetic moments $|\mu(Gd^{155})| : |\mu(Gd^{157})| = 0.73 \pm 0.03$ were determined from the hyperfine structure of paramagnetic resonance in the phosphor SrS Gd. From a comparison of hyperfine splittings in the spectra of Eu^{2+} and Gd^{3+} in phosphor SrS, and employing a value of 3.6 nuclear magnetons for $\mu(Eu^{151})$, the authors obtained:
$|\mu(Gd^{155})| = 0.25$, $|\mu(Gd^{157})| = 0.34$ nuclear magnetons. A.

539.14

6215. THE RATIO OF THE NUCLEAR g-FACTORS FOR B^{11} AND B^{10}. W.Brouwer and H.E.Petch.
Canad. J. Phys., Vol. 36, No. 5, 632-4 (May, 1958).

By a nuclear resonance method the ratio was found to be 2.986 29 ± 0.000 02, in agreement with a previous determination by a similar method but differing significantly from the value obtained from a hyperfine structure determination. D.J.Oliver

539.14 : 530.145

6216. ON NUCLEAR MAGNETIC MOMENT IN MESON FIELD THEORY. S.K.Kundu.
Nuovo Cimento, Vol. 8, No. 6, 888-93 (June 16, 1958).

The nuclear magnetic moment is studied in pseudovector-pseudoscalar charged meson theory with a space-time extended source model and the equivalent energy-momentum cut-off. A.

539.14 : 539.19

DETERMINATION OF THE QUADRUPOLE MOMENT OF N^{14}. See Abstr. 5447

539.14

6217. NUCLEAR SIZES AND DENSITY DISTRIBUTIONS. K.K.Seth.
Phys. Today, Vol. 11, No. 5, 24-9 (May, 1958).

This is a non-specialist report of the International Congress on Nuclear Sizes and Density Distributions, held at Stanford University on December 17-19, 1957. The principal papers are printed in Reviews of Modern Physics, Vol. 30, No. 2, 412 et seq. (April, 1958); individual abstracts of these papers will be published later.

539.14

6218. AN INVESTIGATION OF THE EQUILIBRIUM FORM OF ATOMIC NUCLEI. B.L.Birbrair.
Zh. éksper. teor. Fiz., Vol. 33, No. 5(11), 1235-47 (1957). In Russian.

It is shown that the abrupt transition from the spherical equilibrium form of atomic nuclei to the ellipsoidal form observed in experiment is explained by the influence of pair interaction of nucleons. If the difference between pair energies in the ellipsoidal and spherical states is evaluated from experimental data on the binding energies of the nuclei, then the theoretical regions of prolate nuclei coincide with those observed in experiment. A.

539.14

6219. THE THEORY OF COLLECTIVE EXCITATIONS IN NUCLEI. D.M.Brink.
Rep. Progr. Phys., Vol. 21, 144-64 (1958).

In some regions of the periodic table nuclei show an energy spectrum characteristic of a rotator and appear to have a non-spherical equilibrium shape. Such nuclei have been described successfully by a unified model which exhibits both collective and individual particle aspects of nuclear structure. The model ascribes wave-functions to the low nuclear states which are products of collective wave-functions, representing the rotation of the nuclear deformation, with wave-functions representing the intrinsic motion of nucleons inside the nucleus. Sequences of levels showing the rotational spectrum correspond to states with the same intrinsic wave-function, but with different collective motions. The rotational wave-functions are represented by rotation matrices, and the collective motion is closely analogous to the quantum mechanical rotations of a symmetric top with moment of inertia about half that of an equivalent rigid body. The intrinsic state is approximated by a Hartree—Fock type wave-function, with the individual particle orbitals defined by a deformed potential determined by the nuclear shape. Magnetic dipole and electric quadrupole moments are given by the corresponding intrinsic moments modified by a projection factor depending upon the mode of collective rotation. Hence the intrinsic deformation of the nuclear charge gives rise to large electric quadrupole moments. Within a rotational sequence, electromagnetic transition probabilities depend on the intrinsic electric or magnegic moments and on the rotational modes of the initial and final states. Between rotational sequences, where the intrinsic particle state changes, the transition probabilities depend on an "intrinsic transition probability" modified by parameters determined uniquely by the collective motion. Other nuclei show an energy spectrum of a type which can be associated with a vibration of the nuclear surface. A.

539.14 : 539.17

6220. MEASUREMENT OF THE NEUTRON STRENGTH FUNCTION $\bar{\Gamma}_n^0/D$ FOR NUCLIDES WITH 45 TO 75 NUCLEONS. R.E.Cote, L.M.Bollinger and J.M.LeBlanc.
Phys. Rev., Vol. 111, No. 1, 288-95 (July 1, 1958).

Neutron transmission measurements were made on many of the nuclides whose atomic weights lie between 45 and 75. Parameters of individual resonances were deduced for some of these nuclides and for all of them a value of the strength function $\bar{\Gamma}_n^0/D$ was obtained. The experimental values of the strength function indicate a maximum near A = 53. This is consistent with the prediction of the theory of Feshbach, Porter and Weisskopf for a square-well potential with $V_0 = 44$ MeV, $\zeta = 0.03$ and $R = (1.26\sqrt[3]{A} + 0.7) \times 10^{-13}$ cm. The shape of the observed maximum is not in agreement with this simple theory, however, so a discussion is given which compares the present measurements with predictions based on more realistic models of the nucleus. A.

539.14

6221. SOME PROPERTIES OF THE IRREGULAR ROTATIONAL SPECTRA IN ODD-MASS NUCLEI. L.Simons.
Nuclear Phys., Vol. 7, No. 3, 209-16 (June [3], 1958).

An investigation is made of the spin sequence in the rotational spectra of odd-mass nuclei for the case $K = \frac{1}{2}$. One feature of this investigation is that it leads to a method for rapidly obtaining a survey of the spin sequence in various cases. An alternative interpretation is given, as an example, of the spectrum of Tm^{171} which differs essentially from an earlier interpretation. A.

539.14

6222. A CONTRIBUTION TO THE EXPERIMENTAL INVESTIGATION OF THE EXCITED LEVELS OF SEVERAL LIGHT NUCLEI USING THE ANGULAR CORRELATION OF INTERNAL-CONVERSION PAIRS AND MONOPOLAR PAIRS. R.Armbruster.
Ann. Phys. (Paris), Ser. 13, Vol. 3, No. 1-2, 88-122 (Jan.-Feb., 1958). In French.

Angular correlation theory for internal-conversion electron—positron pairs, and for monopolar pairs is summarized and applied to experimentally observed correlations between the monopolar electron—positron pair from first excited state in O^{16}(6.05 MeV), the internal conversion pair from the first excited state of C^{13}(3.05 MeV) and that from the first excited state of C^{12}(4.43 MeV). The angular correlation of the pair from the O^{16} level was found to be of the form $W(\theta) = 1 + (0.955 \pm 0.007) \cos\theta$ in agreement with a transition between first excited and ground states of known spin and parity (both $J = O^+$). The spins and parities of the first excited state and ground state in C^{13} were deduced to be $J = \frac{1}{2}^+$ and $J = \frac{1}{2}^-$, the internal conversion process of the de-excitation being in competition with de-excitation by the emission of electric dipole radiation. The first excited and ground states of C^{12} were deduced to be $J = 2^+$ and $J = O^+$, internal conversion de-excitation being in competition with de-excitation by the emission of electric quadrupole radiation. Spin parity and isobaric spin assignments for the 16.57 MeV level and 17.22 MeV level in C^{12} of 2^- T = 1 and 1^- T = 1 are made. The crystal β-spectrometer and circuits used in these measurements are described. A.E.I. Research Laboratory

539.14

6223. NUCLEAR ENERGY LEVELS AND MULTIPOLE TRANSITIONS IN THE LEAD REGION. I. I.Bergström and G.Andersson.
Ark. Fys., Vol. 12, Paper 19,415-79 (1957).

A compilation was made of experimental data concerning energy levels of nuclei in the Z-region 77-84. The data include spin, parity and lifetime of the levels as well as energy and conversion ratios of the multipole transitions involved in their de-excitation. K/L and $(L_I + L_{II})/L_{III}$ conversion ratios are found to agree reasonably well with the values obtained from Rose's tables. Regularities in level separations are pointed out and the appearance of certain levels is discussed on the basis of single-particle shell-model predictions. A comparison is made between experimentally determined γ-transition probabilities for E2, E3, E4, E5, and M4 transitions and those calculated from single-particle theory. A marked influence of the magic numbers Z = 82 and N = 126 shows up both in level separations and in transition probabilities. Special attention is paid to the present theoretical and experimental knowledge of levels in nuclei in the immediate neighbourhood of the double magic Pb^{208}. A.

539.14 : 539.166

6224. EXCITED LEVELS OF ^{155}Gd. A.Bisi and L.Zappa.
Nuclear Phys., Vol. 6, No. 2, 252-9 (March [3], 1958).

The γ- and X-ray decay of Eu^{155} was investigated by means of a scintillation spectrometer, proportional counter spectrometer and coincidence technique. A level scheme of Gd^{155} is proposed. A.

539.14

6225. ENERGY LEVELS IN ODD-MASS AND EVEN NUCLEI. A.De-Shalit.
Nuclear Phys., Vol. 7, No. 3, 225-32 (June [3], 1958).

Methods developed by Racah and first used by Talmi for the

study of nuclear spectra are used to derive relations between energy-level spacings in even and odd-mass nuclei in the scheme of the jj-coupling shell model. It is found that the occurrence of close lying states near the ground states of odd-mass nuclei and the absence of such states in even nuclei can be accounted for.

A.

539.14 : 539.17

6226. ENERGY LEVEL SPECTRUM OF C^{15} FROM THE NUCLEAR REACTION $Be^9(Li^7,p)C^{15}$. P.G.Murphy.
Phys. Rev., Vol. 108, No. 2, 421-6 (Oct. 15, 1957).

Energy levels of the nucleus C^{15} were measured by measuring the kinetic energies of proton groups produced in the bombardment of thin beryllium targets with 2 MeV lithium ions, causing the reaction $Be^9(Li^7,p)C^{15}$. The energy levels found were at 0.62, 2.48, 3.08, 4.26, 5.93, 6.58, and 8.18 MeV above the ground state. A continuum of particles was interpreted as due partly to $Be^9(Li^7,pn)C^{14}$. The ground state and the lowest levels were compared with levels in N^{15}; the presence of the lowest $T = \frac{3}{2}$ level at 11.61 MeV in N^{15} was confirmed. Comparison with the low-lying levels in O^{17} revealed similarity suggested by the analogous shell structures of the two nuclei C^{15} and O^{17}.

A.

539.14

6227. NUCLEAR FINE STRUCTURE WIDTHS AND SPACINGS. S.Blumberg and C.E.Porter.
Phys. Rev., Vol. 110, No. 3, 786-7 (May 1, 1958).

Results are presented to support the view that width and spacing distributions can be both derived from a single statistical hypothesis: a normal distribution for the matrix elements of the Hamiltonian. Machine calculated eigenvalues and eigenvectors of matrices with random matrix elements are compared with the spacing distributions obtained analytically for a 2×2 matrix and with the component distribution of a random unit vector. Only the latter distribution is dependent on the assumed dimension of the matrix. A Gaussian distribution for the neutron width is then deduced from the eigenvector component distribution by application of the central limit theorem.

J.Lascoux

539.14 : 539.166:83 : 539.165

ENERGY LEVELS OF Os^{186} AND Os^{188}. See Abstr. 5312

539.14 : 539.166.2

ENERGY LEVELS OF Pt^{192}. See Abstr. 5331

539.14 : 539.166.2

Sm^{152} AND Gd^{152} LEVELS. See Abstr. 5332

539.14 : 539.17

ENERGY LEVELS IN O, Ca AND C NUCLEI. See Abstr. 5341

539.14 : 539.17

Cr^{52} AND Co^{59} ENERGY LEVELS. See Abstr. 5359

539.14 : 539.17

THE ENERGY LEVELS OF U^{233}. See Abstr. 5366

539.14

6228. INVESTIGATION OF THE LIFETIMES OF LOWER NUCLEAR LEVELS EXCITED IN ELECTRON CAPTURE.
E.Ye.Berlovich, K.Grotovski, M.Bonitz, V.I.Breslav and B.K.Preobrazhensky.
Nuclear Phys., Vol. 6, No. 5, 672-85 (May, 1958).

On the basis of X—e and X—γ coincidence studies the following half-life values were found for levels excited in electron capture:

264 keV level in Er^{167}: $T_{\frac{1}{2}} = (2.0 \pm 0.5) \times 10^{-9}$ sec,
121 keV level in Sm^{147}: $T_{\frac{1}{2}} \leq 2 \times 10^{-10}$ sec,
186 keV level in Os^{190}: $T_{\frac{1}{2}} = (5 \pm 2) \times 10^{-10}$ sec,
level of gadolinium (half-life 60 days): $T_{\frac{1}{2}} = (3.5 \pm 1.1) \times 10^{-10}$ sec.

Compared with predictions of the one-particle model, the investigated E2 transition in Os^{190} and the partial E2 transition in Er^{167} are accelerated respectively 50 and 300 times and the partial M1 transition is retarded 160 times. The intrinsic quadrupole moment of Os^{190} is $Q_0 = (4.2 \pm 0.9) \times 10^{-24} cm^2$.

A.

539.14

6229. PRESSURE STUDIES ON THE NUCLEAR MAGNETIC RESONANCE OF SOLID HYDROGEN BETWEEN 1.2°K AND 14°K. G.W.Smith and C.F.Squire.
Phys. Rev., Vol. 111, No. 1, 188-93 (July 1, 1958).

The nuclear magnetic resonance spectrum of solid hydrogen (75% ortho) was studied as a function of temperature from 1.2°K to 14°K and of pressures from 1-300 atm. At 10°K the absorption signal broadens from less than one gauss to 5.3 gauss between slope extrema as the temperature is lowered and self-diffusion ceases. When pressure is applied, this broadening is shifted to higher temperatures by a sizable amount. With 230 atm, a shift of 3.2 de was observed. Correlation times and activation energies of self-diffusion are computed for each of the transitions at various pres ures. The activation energies are linearly dependent upon the tra sition temperatures. The lower transition at 1.5°K in which some rotational degeneracy is removed was also investigated with vario pressures. Pressures up to 216 atm did not shift the transition temperature to any observable extent. Pressures up to 337 atm h no effect on line shape below 1.5°K.

539.

6230. THE NUCLEAR QUADRUPOLE COUPLING CONSTANT C ^{23}Na IN SODIUM NITRATE.
R.G.Eades, D.G.Hughes and E.R.Andrew.
Proc. Phys. Soc., Vol. 71, Pt 6, 1019-20 (June, 1958).

The quadrupole coupling constant was found to decrease by a factor of ten in going from room temperature to just below the λ- transition at 276°C. A possible explanation involves the motion of the nitrate groups and also the sodium nuclei, for which evidence was obtained.

D.J.Oli

539.14 : 539.

SPINS AND PARITIES OF THE $_{\Lambda}H^4$ HYPERFRAGMENT. See Abstr. 6188

539.14 : 539.

DERIVATION OF THE Λ^0—α POTENTIAL FROM HYPERFRAGMENT BINDING ENERGIES. See Abstr. 6194

539.14 : 537.5

A SOURCE OF POLARIZED NUCLEI FOR ACCELERATORS. See Abstr. 5059

RADIOACTIVITY

539.16 : 541.1

REMOVAL OF I^{131} FROM AIR BY ADSORPTION. See Abstr. 5511

539.163 : 539.

6231. GAMMA TRANSITIONS IN THE DECAY OF La^{142}.
H.Ryde and C.J.Herrlander.
Ark. Fys., Vol. 13, No. 2, Paper 15, 177-83 (1958).

The half-lives of the isotopes La^{141} and La^{142}, first reported a fission products by Hahn and Strassmann, were found to be (3.76 ± 0.10) hr and (81 ± 3) min compared with the figures 3.7 hr and 77 min given by Katcoff. The gamma-rays of 0.63 MeV and 0.87 MeV found by Van den Bosch in the decay of La^{142} were verifi Six new gamma-rays with the energies 1.0, 1.8, 2.0, 2.4, 2.9 and 3.4 MeV were found by measurements with a 4×4 in. NaI:Tl crys Coincidence investigations were carried out and a preliminary lev scheme is given for Ce^{142}, the daughter nucleus of La^{142}.

539.1

6232. HALF-LIVES OF THE POSITON EMITTING MIRROR NUCLEIDES. S.E.Arnell, J.Dubois and O.Almén.
Nuclear Phys., Vol. 6, No. 2, 196-202 (March [3], 1958).

The half-lives of the positron emitters C^{11}, N^{13}, F^{17}, Na^{21}, Al^2 and Al^{26}, P^{30} were determined. The decay spectrum of Al^{25} has be investigated. No evidence for γ-rays indicating a complex decay was found. A plot of log $T_{\frac{1}{2}}$ against log $A^{2/3}$ is discussed in terms of shell effects. It is shown that individual lines can be drawn thr the points belonging to successive proton sub-shells. The value f Ne^{19} falls below the line representing the $d_{5/2}$-subshell, which som what favours the proposal that the ground states of Ne^{19} and F^{19} ar $2s_{\frac{1}{2}}$-states. From a plot of the β^+-energies the pairing energy difference seems to have a value of about 0.1 MeV in the $d_{5/2}$-subshell.

539.163 : 539

6233. LEVELS IN Dy^{161}. I. EXPERIMENTAL INVESTIGATION F THE DECAY OF Tb^{161}.
P.G.Hansen, O.Nathan, O.B.Nielsen and R.K.Sheline.
Nuclear Phys., Vol. 6, No. 5, 630-44 (May, 1958).

The decay of Tb^{161} was re-investigated by means of scintillati spectrometers, a six-gap β-ray spectrometer, and coincidence te niques. The following transitions were observed (energies in keV 25.6 (E1), 28.7, 48.9 (M1), 57.1 (M1), 74.5 (E1), 77.6, 106 (M1 or E 132 (tentative). Lifetime measurements and coincidence experim show unambiguously the existence of levels in Dy^{161} with energies 25.6, 74.5 and 132 keV. A level has tentatively been placed at

03.3 keV. The half-lives of the 25.6 and 74.5 keV states are $2.8 \pm 0.2) \times 10^{-8}$ sec and $(3.0 \pm 0.3) \times 10^{-9}$ sec. The β-spectrum ontains a ground-state transition with end point at (610 ± 15) keV nd groups of (525 ± 15) and (460 ± 15) keV to the 74.5 and 132 keV evels. A.

539.163 : 539.14

6234. LEVELS IN Dy^{161}. II. THEORETICAL. D.R.Bès.
Nuclear Phys., Vol. 6, No. 5, 645-54 (May, 1958).

The experimental evidence on Dy^{161} (see preceding abstract) is hown to be in accord with the predictions of the unified model. Certain effects due to the Coriolis force are verified. A.

539.163

6235. SHORT-LIVED ISOTOPES OF Pd AND Ag OF MASSES 113-117. J.M.Alexander, U.Schindewolf and C.D.Coryell.
Phys. Rev., Vol. 111, No. 1, 228-36 (July 1, 1958).

Six new short-lived Pd and Ag isotopes were isolated from the ission products by fast chemical separations. Their decay proper- ies were studied by β and γ counting and spectroscopy or by periodic xtractions of daughter activities. The nuclides described are: .4 min Pd^{113} decaying to 1.2 min Ag^{113m} and 5.3 hr Ag^{113}; 2.4 min Pd^{114} from which 5 sec Ag^{114} was extracted; 45 sec Pd^{115} which decays to about 20 sec Ag^{115m} and 21.1 min Ag^{115}; 2.5 min Ag^{116}; and .1 min Ag^{117} which gives rise to the complicated decay chain of Cd^{117} and In^{117}. A.

539.163

6236. ATTEMPTS TO CONFIRM THE EXISTENCE OF THE .0-MINUTE ISOTOPE OF 102.
A.Ghiorso, T.Sikkeland, J.R.Walton and G.T.Seaborg.
Phys. Rev. Letters, Vol. 1, No. 1, 17-18 (July 1, 1958).

No evidence for the existence of this isotope could be obtained sing the method described by Fields et al. (Abstr. 317/1958) and it s concluded that the activity found by them cannot be ascribed to lement 102 (see, however, following abstract). M.A.Grace

539.163

6237. ELEMENT No. 102.
A.Ghiorso, T.Sikkeland, J.R.Walton and G.T.Seaborg.
Phys. Rev. Letters, Vol. 1, No. 1, 18-21 (July 1, 1958).

An α-emitting element of 3 sec half-life was prepared by C^{12} ombardment of Cm. This activity was identified by its decay roducts and is attributed to 102^{254} produced by the $Cm^{246}(C^{12},4n)$ eaction. M.A.Grace

539.163

6238. NEW ISOTOPE OF BERYLLIUM.
M.J.Nurmia and R.W.Fink.
Phys. Rev. Letters, Vol. 1, No. 1, 23-4 (July 1, 1958).

A natural boron target was bombarded by 14 MeV neutrons and his showed a high-energy β-activity of half-life 14.1 ± 0.3 sec hich is attributed to Be^{11} formed by the $B^{11}(n,p)$ reaction. A value 0.0 ± 1.5 is found for the cross-section ratio $(n,\alpha)/(n,p)$ at this nergy. M.A.Grace

539.163.1 : 539.14

6239. ROTATIONAL CHARACTER OF THE TRANSITION FROM THE 473 keV LEVEL IN Tm^{169}. O.Nathan and I.Marklund.
Nuclear Phys., Vol. 6, No. 1, 102-6 (March [2], 1958).

The lifetime of the 473 keV state of Tm^{169} was investigated by neans of a β-ray spectrometer operated in coincidence with a NaI cintillation detector. An upper limit of $\cong 5 \times 10^{-8}$ sec is obtained or the half-life, which is consistent with a rotational interpretation f this state. A.

539.163.1 : 539.14

6240. ISOMERIC STATE IN Bi^{206}. E.Arbman and P.A.Tove.
Ark. Fys., Vol. 13, Paper 4, 61-7 (1957).

A half-life of 7.8 ± 0.3 μsec was measured for the 59.9 keV 2-transition in Bi^{206}. Delayed coincidence studies show that all trong gamma-rays from the decay of Po^{206} precede the 59.9 keV ransition. The spins of the levels in Bi^{206} are discussed. A.

539.163.2 : 539.14

6241. THE DECAY SCHEME OF $B^{212} \rightarrow Po^{212}$.
A.G.Sergeev, É.M.Krisyuk, G.D.Latyshev, Yu.N.Trofimov and A.S.Remennyĭ.
Zh. éksper. teor. Fiz., Vol. 33, No. 5(11), 1140-3 (1957). In Russian.

On the basis of data obtained in an investigation of the conversion pectrum of an active precipitate of radiothorium, an attempt was nade to verify the decay scheme of $Bi^{212}(\beta)Po^{212}$. It is shown that part from the well-known levels of 727.2, 1620.5, 1679.9 and 800.4 keV, the decay scheme of Bi^{212} has a level with an energy of 512.6 keV. Suppositions made in the literature concerning the existence of levels of 830, 2180, 2200, and 2230 keV were not confirmed experimentally. The possibility of the existence of vibrational levels in Po^{212} is discussed. A.

539.163.2

6242. THE DECAY SCHEME OF Tl^{208}.
É.M.Krisyuk, A.G.Sergeev, G.D.Latyshev, K.I.Il'in and V.I.Fadeev.
Zh. éksper. teor. Fiz., Vol. 33, No. 5(11), 1144-6 (1957).
In Russian.

On the basis of an investigation of the conversion electrons spectrum, an attempt is made to verify the decay scheme of Tl^{208}. It is shown that the spin of the ground state of Tl^{208} is 5^+, while the spin of the 3.961 MeV level of Pb^{208} is 6^-. It is assumed that there exists a 3.750 MeV level with a spin of 7^-. All excited levels of Pb^{208} are explained by the excitation of one proton. A.

539.164

6243. ON THE INTERACTION BETWEEN THE α-PARTICLE AND THE PROTON IN THE $Po^{210}H_2$ MOLECULE. D.K.Yovanovitch.
C.R. Acad. Sci. (Paris), Vol. 246, No. 5, 746-8 (Feb. 3, 1958).
In French.

The relatively large numbers of protons ejected by the α's from Po^{210} in $Po^{210}H_2$ were observed in nuclear emulsions, and require a wave-mechanical explanation. E.J.Burge

539.164.08

6244. A SEARCH FOR α-PARTICLES FROM THE DECAY OF Bi^{209}. E.P.Hincks and C.H.Millar.
APPENDIX: THE EXPECTED α-HALF-LIFE OF Bi^{209}.
G.C.Hanna.
Canad. J. Phys., Vol. 36, No. 2, 231-47, 247-54 (Feb., 1958).

A search for α-particles from Bi^{209} was carried out in Ilford C-2 bismuth-loaded nuclear emulsions maintained at 5°C for 3 years before development. Contrary to the findings of Faraggi and Berthelot (1951), Riezler and Porschen (1952) and Porschen and Riezler (1956), no evidence was obtained of α-particles in the 3 MeV region which could be unambiguously attributed to bismuth, the experimental lower limit for the half-life thus determined being $T_{1/2} \geq 2 \times 10^{18}$ years. A detailed study of the energy available for the α-disintegration of Bi^{209} by the method of reaction-cycles gives a value of 2.93 ± 0.11 MeV. For this disintegration energy the half-life of Bi^{209} predicted on the basis of α-decay theory and systematics is between 5×10^{19} and 5×10^{23} years. A.

539.165

6245. DETERMINATION OF β-SPECTRA END-POINTS BY THE GAS ABSORPTION METHOD. L.Danguy and R.Quivy.
Bull. Acad. Roy. Belgique Cl. Sci., Vol. 43, No. 11, 847-53 (1957).
In French.

β-emitters were placed in a pressure vessel at a distance of some 20 cm from a scintillation detector (pamelon) and the counting rate recorded as a function of gas pressure. It was found that the gas densities required to reduce the counting rate to one half were closely proportional to the maximum energies of the β-rays, so that the method could be used as relatively quick, accurate and simple method for measuring end-points in unknown β-spectra.
A.E.I. Research Laboratory

539.165 : 539.166.83

6246. STUDY OF Tb^{160}.
M.P.Abotina, E.P.Grigor'ev, A.V.Zolotavin and B.Kratsik.
Dokl. Akad. Nauk SSSR, Vol. 119, No. 6, 1127-30 (1958). In Russian.

The continuous B-spectrum, the spectrum of conversion electrons, and that of photoelectrons of radioactive Tb^{160} were measured using a double-focusing spectrometer. G.E.Brown

539.165 : 539.166

6247. THE INTERNAL COMPTON EFFECT.
A DETERMINATION OF CROSS SECTION AND ANGULAR CORRELATION. T.Lindqvist, B.G.Pettersson and K.Siegbahn.
Nuclear Phys., Vol. 5, No. 1, 47-57 (Jan., 1958).

The internal Compton effect, a nuclear transition in which there is a simultaneous ejection of a bound electron and emission of a gamma ray, was unambiguously demonstrated. The experiment concerned the 662 keV transition in Ba^{137m} and was carried out with a gamma scintillation spectrometer and a beta-ray spectrometer in coincidence. The presence of other effects was carefully considered. The experimental cross-section was found to be 1.86×10^{-5} photons in the energy region 97 keV-120 keV per conversion electron at 90° between the electron and photon directions. Angular correlation experiments were carried out. Comparison with various theories shows that the theory by Spruch and Geotzel (Abstr. 8614/1954) does fit the experimental results

excellently both regarding absolute cross-section and angular correlation. A.

539.165 : 539.166

6248. BETA AND GAMMA RAY SPECTROSCOPY OF Cs^{137}. Y.Yoshizawa.
Nuclear Phys., Vol. 5, No. 1, 122-40 (Jan., 1958).

Beta-rays and internal-conversion electrons from Cs^{137} were studied using a two-directional focusing beta-ray spectrometer (ρ = 40 cm). The K-shell conversion coefficient α_K of 661 keV gamma-transition was found to be 0.0976 ± 0.0055, and K/L/M to be (5.66 ± 0.04)/1/(0.260 ± 0.003), which are in good agreement with Rose's calculated values for the M4 transition. The maximum energy of the lower component of the beta-rays was found to be 514 ± 2 keV. The Kurie plot, corrected by the factor of the unique first forbidden transition, shows a straight line. The spectrum of the higher component was interpreted by the second forbidden correction factor with a linear combination of scalar and tensor interactions. In an attempt to determine the sign of the ratio of scalar to tensor interaction constants, G_S/G_T, the spectrum could be only explained by the negative sign, assuming that the single-particle model is a good approximation for the nuclear matrix elements. A.

539.165

6249. THE ELECTRON—NEUTRINO ANGULAR CORRELATION IN DECAY OF Ne^{23}. B.W.Ridley.
Nuclear Phys., Vol. 6, No. 1, 34-49 (March [2], 1958).

The electron—neutrino angular correlation in decay of Ne^{23} was determined by measuring the distribution of electron energies and recoil momenta without selection of angle. The angular correlation parameter α was found to be −0.05 ± 0.10. This implies a ratio of coupling strengths of the axial vector and tensor parts of the Gamow—Teller interaction within the limits $0.85 \leq |C_A|/|C_T| \leq 1.62$. A.

539.165 : 539.166

6250. BETA—NEUTRINO—GAMMA ANGULAR CORRELATION. M.Morita.
Nuclear Phys., Vol. 6, No. 1, 132-4 (March [2], 1958).

The correlation function was calculated for an allowed beta-transition followed by a gamma of arbitrary multipole mixture, the polarization of the photon being also taken into account.

P.K.Kabir

539.165 : 539.166

6251. (β,γ) CIRCULAR POLARIZATION CORRELATION FOR Co^{60} AND Na^{22}. H.Appel, H.Schopper and S.D.Bloom.
Phys. Rev., Vol. 109, No. 6, 2211-12 (March 15, 1958).

The asymmetry coefficients were measured as (−0.335 ± 0.018) for Co^{60} and (+0.295 ± 0.054) for Na^{22}, and the angular dependence on $\cos\theta$ was confirmed for Co^{60}. M.A.Grace

539.165 : 539.18

IONIZATION FOLLOWING BETA DECAY IN KRYPTON-85.
See Abstr. 5420

539.165 : 539.166

6252. THE CIRCULAR POLARIZATION OF INTERNAL AND EXTERNAL BREMSSTRAHLUNG. H.Schopper and S.Galster.
Nuclear Phys., Vol. 6, No. 1, 125-31 (March [2], 1958).

The circular polarization of internal and external bremsstrahlung was measured as a function of photon energy for the decay of $Sr^{90} + Y^{90}$. The experimental results are in general agreement with theoretical predictions assuming maximum violation of parity and ST- or VA-interaction. A.

539.165

6253. RELATIVE MEASUREMENTS OF THE POLARIZATION OF β-PARTICLES FROM Tl^{204}, Au^{198}, $Sr^{90} + Y^{90}$. J.Heintze.
Z. Phys., Vol. 150, No. 2, 134-43 (1958). In German.

A method, which uses combined multiple and single scattering to measure the polarization of β-particles, is further developed for precise measurements of relative polarizations. The depolarization through self-scattering in the source is investigated experimentally, and the energy-dependence of the apparatus is also discussed. From the comparison of the polarizations of the β-particles from Tl^{204} and Au^{198}, the polarization for Au^{198} is found as $P = -(0.98 \pm 0.05)\ v/c$, if one assumes $P = -v/c$ for the pure Gamow—Teller transition in Tl^{204} ($v/c \cong 0.7$-0.9). P.K.Kabir

539.165

6254. β-TRANSITION BETWEEN THE GROUND STATES OF Co^{58} AND Fe^{58}. H.Daniel.
Z. Phys., Vol. 150, No. 2, 144-8 (1958). In German.

Describes the measurement of the β -spectrum of Co^{58} by means of a double-focusing β-spectrometer. A doubly-forbidden ($ft \sim 6 \times 10^{-6}$) transition between the ground states of Co^{58} and Fe^{58} was detected, and within the (rather large) statistical uncertainties of the experiment the mixing ratio λ between electron and neutrino momentum determined. J.W.Gardn

539.165 : 530.1

6255. β-DECAY AND NON-CONSERVATION OF PARITY. V.B.Berestetsky, B.L.Ioffe, A.P.Rudik and K.A.Ter-Martirosyan.
Nuclear Phys., Vol. 5, No. 3, 464-94 (Feb., 1958).

Effects due to non-conservation of parity such as longitudinal and transverse polarization of β-electrons, angular distribution of β-electrons from an oriented nucleus (including the case when the direction of the recoil nucleus momentum is fixed) are examined in the present paper for the cases of allowed β-transitions and first-order forbidden transitions. It is shown that owing to the influence of the Coulomb field the magnitude of these effects for forbidden transitions in heavy and intermediate nuclei is the same as for allowed transitions. Perceptible deviations are observed in light nuclei ($Z < \sim 20$). In the particular case of a 0—0 transition comparison with experiment may yield important data on the contribution of pseudoscalar coupling. Unique transitions ($\Delta j = 2$, yes) for which the electron angular distribution of oriented nuclei essentially differs from that for allowed transitions are considered separately

539.1

6256. ANGULAR CORRELATION BETWEEN RECOIL NUCLEUS AND GAMMA QUANTUM IN ELECTRON CAPTURE. J.Zimányi.
Nuclear Phys., Vol. 6, No. 5, 625-7 (May, 1958).

The ν—γ angular correlation is obtained for allowed K-capture. For a Fermi transition there is no correlation, for a Gamow—Teller transition the correlation is given in the present paper and it is found to be the same for T and A coupling, depending only on the polarization of the neutrino.

539.165.07 : 539.166.

6257. APPLICATION OF THE SIEGBAHN-SLÄTIS BETA-RAY SPECTROMETER TO PAIR SPECTROSCOPY. J.Kjellman and B.Johansson.
Science Tools, Vol. 5, No. 1, 1-5 (April, 1958).

An intermediate-image beta-ray spectrometer was adapted for measurements of high-energy gamma-rays from cyclotron-induced reactions by means of the statistical-separation pair detection technique. For the testing and calibration of the equipment, the 6.065 ± 0.009 MeV pair emitting state in O^{16} was used. A method for using the spectrometer for the measurement of short half-lives of excited states is described. In this application, the natural phase bunching of the cyclotron is used to indicate the time when a state is born.

539.165.2 : 539.1

6258. A FOUR-STATE THEORY OF THE NEUTRINO. P.E.Cavanagh, C.F.Coleman, B.W.Ridley and J.F.Turner.
Nuclear Phys., Vol. 5, No. 1, 11-16 (Jan., 1958).

A scheme of coupling constants for the beta-decay interaction is proposed to explain a wide range of experimental results. The scheme assumes a four-state neutrino. It implies that all electron polarization measurements will yield one or the other of the values ± v/c, whatever the values of the ratios C_T/C_A and C_S/C_V.

539.165

6259. PARITY NON-CONSERVATION AND TRANSVERSE POLARIZATION OF β-PARTICLES. G.Györgyi and H.Überall.
Nuclear Phys., Vol. 5, No. 2, 405-8 (Jan. [2], 1958).

The transverse polarization of β-particles, which is present when the neutrino is also detected in β-decay, is calculated using the general parity non-conserving Hamiltonian of Lee and Yang. The possibility of observing this transverse polarization experimentally is also discussed. P.K.Kabi

539.165.2 : 530.

6260. BETA—GAMMA CORRELATION AND POLARIZATION OF PARTICLES IN THE BETA DECAY OF ORIENTED NUCLEI IN CONNECTION WITH PARITY NON-CONSERVATION. A.Z.Dolgino
Nuclear Phys., Vol. 5, No. 3, 512-29 (Feb., 1958).

A formula for the angular distribution and polarization of β-particles emitted by polarized or aligned nuclei is derived; the formula is valid for β-transitions of any order of forbiddenness. The investigation is carried out for β-interaction of a general form with possible parity non-conservation being taken into account. The β—angular and polarization correlation is determined. As a way of clarifying the problem of invariance of the theory under time reversal

s suggested that $\beta-\gamma$ correlation in allowed transitions of aligned uclei be studied. It is taken into account in the calculations that ne field inside the nucleus differs from that of a point charge.

A.

539.165.2 : 539.12

261. ANGULAR DISTRIBUTION AND POLARIZATION OF LECTRONS EMITTED IN THE β-DECAY OF ALIGNED NUCLEI.
M.Shmushkevich.
h. éksper. teor. Fiz., Vol. 33, No. 6(12), 1477-82(1957). In Russian.

Angular distribution and polarization of electrons (positrons) mitted in β-decay of aligned nuclei are calculated for allowed trans-ions taking into account parity non-conservation. A.

539.165.2

262. MESONIC EFFECTS IN BETA-DECAY.
S.Bell and R.J.Blin-Stoyle.
uclear Phys., Vol. 6, No. 1, 87-99 (March [2], 1958).

It is found impossible to give a consistent account of mirror ansitions involving nuclei with LS-closed cores plus or minus one article in terms of conventional beta-decay theory and using shell-odel wave-functions. Possible explanations of the discrepancies re discussed and it is concluded that there is some evidence for esonic effects of an exchange character. A.

539.165.2

263. CALCULATION OF SOME RELATIVISTIC CORRECTIONS O THE ALLOWED AND l-FORBIDDEN BETA TRANSITIONS.
.Alaga, L.Šips and D.Tadić.
uclear Phys., Vol. 6, No. 2, 305-9 (March [3], 1958).

Making use of the non-relativistic form of the relativistic perators, the authors computed the corrections to the allowed -transitions. The main contributions are of the order of magnitude $\mathrm{M}^{-1}(\alpha Z/r_0)$, p/M and q/M. This may affect the spectra, angular orrelations, K/β^+ ratios and half lives to the extent of a few per ent. It seems that these effects in some cases are within the recision of present day experimental technique and may provide dditional information on β-coupling constants. A.

539.165.2 : 539.12

264. INNER BREMSSTRAHLUNG AND THE MAGNETIC OMENT OF THE NEUTRINO. W.Gold and L.Spruch.
hys. Rev., Vol. 110, No. 1, 290-1 (April 1, 1958).

The contribution, linear in the neutrino magnetic moment, to nner bremsstrahlung in beta decay is calculated. It is zero on the wo-component theory, and difficult to detect in any case.

J.C.Taylor

539.165.2

265. POSSIBLE EXPERIMENTS FOR DETERMINATION OF ETA INTERACTIONS. I. M.Morita, R.S.Morita and M.Yamada.
hys. Rev., Vol. 111, No. 1, 237-44 (July 1, 1958).

Some possible experiments are proposed for deciding the elative strength of scalar and vector interactions and that of tensor nd axial vector interactions in beta decay. For all the proposed xperiments, it is necessary to measure the recoil of the nucleus irectly or the nuclear resonance fluorescence caused by a gamma-ay which follows the beta decay or K capture. Formulae are given or decays involving the beta—gamma cascades and K capture—amma—gamma cascades. Possible experiments are described for ecays involving beta—gamma—gamma cascades. These experi-ents will also determine whether the beta interaction is the same or both signs of the electric charge. A.

539.165.2 : 530.145

266. ON THE FORM OF β-INTERACTION.
G.R.Khutsishvili and S.G.Matinyan.
Zh. éksper. teor. Fiz., Vol. 33, No. 5(11), 1150-3 (1957). In Russian.

The effect of non-conservation of parity on interpretation of he experimental data involving Fierz interference and angular $\beta-\nu$ correlation is considered. Formulae are obtained for β-decay of polarized nuclei. A.

539.165.2 : 530.145

"COMBINED PARITY" CONSERVATION FOR BETA NTERACTION. See Abstr. 5616

539.165.2 : 539.12 : 530.145

CONSERVATION OF LEPTON NUMBER IN BETA-DECAY. ee Abstr. 5622

539.166 : 612.014.481/.482

267. GAMMA RADIATION FROM SOME SWEDISH FOODSTUFFS.
R.M.Sievert, S.Gustafsson and C.G.Rylander.
Ark. Fys., Vol. 12, Paper 20, 481-9 (1957).

The γ-radiation from powdered milk, beef, bone from cattle, and vegetables, collected and preserved in the years 1952-56, was investigated in May—September 1956 by means of two high-pressure ion chamber apparatuses placed in a low background laboratory. In every case a significant increase has been observed which seems to originate from fallout from atomic bomb tests. Investigations of the γ-radiation from children were repeated, but no increase could be observed in comparison with earlier tested subjects in approximate ly the same age and weight classes (101 subjects, 1954; 79 subjects, 1956). Some further measurements of γ-radiation from powdered milk, beef, bone, and thyroid from grazing cattle were added in the proof. A.

539.166

6268. A STUDY OF THE GAMMA RAYS OF Pb^{206} FROM THE DECAY OF Bi^{206} BY THE METHOD OF EXTERNAL CONVERSION IN URANIUM. T.Novakov, S.Hultberg and B.Andersson.
Ark. Fys., Vol. 13, No. 2, Paper 11, 117-28 (1958).

Relative intensities of 20 gamma rays following the decay of Bi^{206} were determined from a beta-spectrometric study of photo-electrons ejected in a 3 mg/cm^2 uranium converter. The instru-mental resolution was 0.4% at high energies. A new method of analysis of the recorded photolines was applied. Together with the earlier measurements of the internal conversion by Alburger and Pryce, the gamma-ray intensities found permitted a determination of relative conversion coefficients with an accuracy of about 15%. In most cases the earlier multipolarity assignments were confirmed. A.

539.166

6269. THE EFFECT OF INTERACTIONS ON THE ANGULAR DISTRIBUTION OF γ-RAYS FROM AN ASSEMBLY OF ORIENTED NUCLEI. J.M.Daniels.
Canad. J. Phys., Vol. 35, No. 9, 1133-45 (Sept., 1957).

The angular distribution of γ-radiation from an assembly of nuclei oriented by the magnetic h.f.s. method can be very much modified by interactions between the radioactive ions and other paramagnetic ions in the crystal. In order to calculate the effect of these interactions, an operator Γ is derived which represents the angular distribution of γ-rays from a radioactive nucleus. The angular distribution at any temperature is given by $\mathrm{spur}(\Gamma\rho)$, where ρ is the statistical matrix $\exp(-\mathcal{H}/kT)/\mathrm{spur}[\exp(-\mathcal{H}/kT)]$, $\mathcal{H}$ being the Hamiltonian for the whole crystal. For a high temperature approximation, ρ is expanded in powers of 1/T. It is found that, for alignment by the magnetic h.f.s. method, the first term which con-tains interaction parameters is that in $1/T^4$, and an expression is given for the contribution of interactions to this term. At very low temperatures, perturbation theory is used to estimate the effect of interactions on the lowest nuclear energy state, and hence on the angular distribution of γ-rays. It is found that, if an external mag-netic field is applied along a principal axis of the g-tensor of the radioactive ions, interactions have no influence on the angular distribution of γ-rays in the limit of large fields. It is also shown that Bleaney's restriction, that for a successful nuclear orientation experiment the broadening of the levels should be less than the hyperfine splitting, is not necessary in this case. A.

539.166 : 539.14

6270. ANGULAR DISTRIBUTION AND LINEAR POLARIZATION OF THE GAMMA RAYS FROM ORIENTED ^{56}Co NUCLEI.
A.N.Diddens, W.J.Huiskamp, J.C.Severiens, A.R.Miedema and M.J.Steenland.
Nuclear Phys., Vol. 5, No. 1, 58-88 (Jan., 1958).

Measurements are reported on the beta—gamma and gamma—gamma coincident radiation observed in the decay of Co^{56} and on the angular distribution and linear polarization of the gamma-rays emitted by oriented Co^{56} nuclei. Discrepancies between various proposed decay schemes were removed by means of coincidence measurements (performed at room temperature). Experiments with oriented nuclei (using low-temperature techniques) gave information about the multipole order of the gamma-rays, the mixing ratio of two multipoles and the electric or magnetic charac-ter of the transitions. As a result, evidence is presented for a decay scheme of Co^{56} and for spin and parity assignments to the excited levels in Fe^{56}. A possible theoretical interpretation of some of these levels is discussed. A review is given of the data available from other experiments. A.

539.166

6271. ON THE 2450-3400 keV REGION OF THE RaC GAMMA SPECTRUM. B.Dzhelepov, S.Shestopalova and I.Uchevatkin.
Nuclear Phys., Vol. 5, No. 3, 413-15 (Feb., 1958).

Five new RaC γ-lines are reported of higher energy than those known heretofore. A.

539.166

6272. ON THE GAMMA-SPECTRA OF Ag^{110}, Sb^{124} AND $Eu^{152, 154}$. B.S.Dzelepow and N.N.Zhukovsky.
Nuclear Phys., Vol. 6, No. 5, 655-68 (May, 1958).

The elotron, a recoil electron gamma-spectrometer with improved focusing properties, was used to study the gamma-radiation from Ag^{110}, Sb^{124} and $Eu^{152, 154}$. A.

539.166

6273. POLARIZATION MEASUREMENTS OF GAMMA RADIATION FROM SULPHUR-34. G.G.Shute and P.S.Fisher.
Phil. Mag. (Eighth Ser.), Vol.3, 726-37 (July, 1958).

Polarization measurements were made on the gamma cascade in S^{34}. The experimental results are consistent with a spin sequence 2^+, 2^+, 0^+ with a mixture of M1 and 1.5% of E2 in the first transition. The theoretical analysis of polarization—direction correlations with mixing included is discussed in some detail. Shell model assignments for the gamma cascade are given with possible explanations of the mixing ratio value obtained. A.

539.166

6274. CIRCULAR POLARIZATION OF A^{37} INTERNAL BREMSSTRAHLUNG. L.G.Mann, J.A.Miskel and S.D.Bloom.
Phys. Rev. Letters, Vol. 1, 34-6 (July 1, 1958).

The circular polarization of the bremsstrahlung was measured by forward scattering off magnetized iron and shown to be 0.97 ± 0.15, the polarization being right circular. This is consistent with the 2-component neutrino theory and yields an upper limit of about 8% for the ratio $|C_T|^2/|C_A|^2$. M.A.Grace

539.166.07 : 537.531.07

6275. A VERSATILE INSTRUMENT FOR THE MEASUREMENT IN r UNITS OF RADIATION DOSES. R.M.Sievert.
Ark. Fys., Vol. 12, Paper 11, 295-300 (1957).

The need is stressed for extensive investigations of the doses received in occupational work with ionizing radiations, by patients undergoing medical X-ray examinations, and from the natural radiation. A simple instrument, based on the condenser chamber principle, for the measurement of X-rays and γ-radiation in the range from the natural level of γ-radiation up to 150 r was designed for such investigations. A similar instrument is used for large stationary ion chambers, where the voltage is read by means of an attached condenser which can be sent by mail. A.

539.166.07

6276. NaI SUMMING SPECTROMETER.
P.Shapiro and R.W.Higgs.
Rev. sci. Instrum., Vol. 28, No. 11, 939-41 (Nov., 1957).

An extension of previous work on the analysis of pulse height distributions obtained with gamma-ray sources placed inside well-type NaI(Tl) crystals is discussed. Two methods are given for the determination of the photopeak efficiency of these NaI spectrometers. It is shown that the summing property of the well-type crystal can be used to obtain the source strength and to yield information on the decay scheme of gamma-ray sources. The photofraction, photopeak efficiency and resolution are given for a 5 in. diameter by 3 in. long NaI crystal with a 1 in. diameter well. A.

539.166.2 : 539.165.2

6277. ON THE SYSTEMATICS OF TRANSITION PROBABILITIES OF M4 TRANSITIONS OF THE TYPE $h_{11/2} \rightarrow d_{3/2}$. DECAY OF Te^{133m}. T.Alväger and G.Oelsner.
Ark. Fys., Vol. 12, Paper 13, 319-30 (1957).

A careful analysis is made of the radial matrix elements of M4 transitions of the type $h_{11/2} \rightarrow d_{3/2}$. It has previously been claimed that the matrix elements systematically increase towards the magic numbers. Especially the matrix elements of Te^{133m} was found to be large in comparison with the matrix elements of the other Te isomers. For this reason the decay of Te^{133m} was studied. The half-life of the isomeric state was found to be 53 ± 4 min with a decay energy of 334.0 ± 0.3 keV. Further, a large β-branching of 87% from the isomeric level was found. This reduces the empirical matrix element of Te^{133m} to the order of magnitude of the other matrix elements in the isomers of tellurium. It must therefore be concluded that there are no certain experimental proofs that the matrix elements of M4 transitions are larger when shells are almost filled. A.

539.166.2

6278. THE ANALYSIS OF ANGULAR AND DIRECTION-POLARIZATION [GAMMA-RAY] CORRELATION MEASUREMENTS ON MIXED TRANSITONS. C.F.Coleman.
Nuclear Phys., Vol. 5, No. 3, 495-503 (Feb., 1958).

When two experimently observed quantities a_{exp}, b_{exp} are give theoretically as known functions a(t), b(t) of a continuous variable t, a comparison between the experimental results and the theoretical predictions can be made by plotting the curve $x = a(t)$, $y = b(t)$, and noting whether the point $x = a_{exp}$, $y = b_{exp}$ lies on it. This allows a very direct comparison of the measured values of the angular correlation parameters A_2, A_4 for the γ—γ coincidences with the theoretical predictions for any spin sequence involving a single mixed transition. Comparison between numbers of experimental and theoretical results on a single graph becomes possible, and the technique can also be used for direction-polarization correlations involving a single mixed transition. A.

539.166.8

6279. FINITE SIZE EFFECTS ON M1 CONVERSION COEFFICIENTS. A.S.Reiner.
Nuclear Phys., Vol. 5, No. 3, 544-56 (Feb., 1958).

Finite size effects in M1 conversion coefficients are calculated using the collective model. For transitions within one rotational band corrections relative to Sliv's conversion coefficient can be as large as 50% in favourable cases. As an example of transitions between different rotational bands the 482 keV transition in Ta^{181} is discussed. The theory predicts a value of β(theoretical)/β(point-nucleus) $\approx$ 20, whereas the observed value is 5 ± 2. Corrections on static magnetic moments, as discussed by Bohr and Weisskopf, are estimated for elements in the same region. A

539.166.8

6280. TRANSITIONS IN Hg^{199} FOLLOWING THE DECAY OF Au^{199}. G.Bäckström, O.Bergman and J.Burde.
Nuclear Phys., Vol. 7, No. 3, 263-75 (June [3], 1958).

The energies of the three gamma-lines in Hg^{199} were measured absolutely, using an iron-free double-focusing spectrometer for conversion electrons from Au^{199}. The atomic binding energy was also absolutely determined. Relative L-subshell conversion intensities were found to yield accurate information on the multipolarity. Relative M-shell conversion coefficients were compared with theory. Partial transition probabilities were computed, and the effect of l-forbiddenness was studied. A

539.166.83 : 539.14

6281. LOW ENERGY γ-TRANSITIONS IN Tu^{169}.
K.N.Shlyagin and P.S.Samoilov.
Zh. éksper. teor. Fiz., Vol. 34, No. 1, 29-32 (1958). In Russian.

A magnetic β-spectrometer was employed to measure the electron spectrum of Yb^{169} in the 3-70 keV energy range. The relative intensities of the detected electron conversion lines are: (a) for the 8.32 keV γ-transition — $M_I : M_{II} : M_{III} : M_{IV} = 1 : 0.42 : 0.48 : 0.10$; (b) for the 20.65 keV γ-transition — $L_I : L_{II} : L_{III} = 1.0 : 0.14 : 0.03$; $M_I : M_{II-V} = 1 : 0.2$. The type of the 8.32 keV transition is found to be M1 + E2 (<3%), and that of the 20.65 keV transition M1. A

539.167 : 778.3

6282. PREPARATION OF XENON-133 RADIOGRAPHY SOURCES FROM SPENT FUEL.
E.J.Wilson, H.P.Dibbs, S.Richards and J.D.Eakins.
Nucleonics, Vol. 16, No. 4, 110, 112-14 (April, 1958).

Irradiated uranium slugs (2.3 kg) were dissolved in nitric acid and the evolved gases purified by passing over heated copper and uranium. The xenon was then adsorbed on charcoal. Specific activities of 100 curies/cm^3 were achieved. R.D.Smith

539.167.3

6283. ON THE ENRICHMENT OF ARSENIC-76 BY HOT-ATOM EFFECT. N.Saito, M.Furukawa and I.Tomita.
J. chem. Phys., Vol. 27, No. 6, 1432-3 (Dec., 1957).

After irradiating arsenate-loaded, anion exchange resin with neutrons at low flux (10^7 neutrons/cm^2 sec) the first fraction of effluent from the column contained approximately 50% of the radioactivity. The As^{76} atoms were in the +3 oxidation state and the specific activity was 1500 times that obtained from a similar bombardment of As_2O_3. Although the use of anion exchange resin appear to give a greater enrichment than from cation exchangers, the resin cannot be used in the higher flux densities found in a nuclear reactor. J.R.Mallard

NUCLEAR REACTIONS

539.17

284. CROSS-SECTIONS FOR ABSORPTION OF HIGH-ENERGY 'ARTICLES BY NUCLEI AND FOR INTERACTION OF HIGH- :NERGY PARTICLES WITH BOUND NUCLEONS. G.Philbert. :.R. Acad. Sci. (Paris), Vol. 246, No. 4, 591-4 (Jan. 27, 1958). n French.

The experimental results on high-energy scattering and absorption cross-sections are examined to investigate the effect of binding on the nucleon cross-sections. It is provisionally concluded that bsorption cross-sections are different for bound and free nucleons. The effect of the range of nuclear forces on previous calculations Abstr. 7358/1957) of absorption of high-energy particles by nuclei s also discussed. L.L.Green

539.17

285. DIRECT AND COMPOUND PROCESSES IN NUCLEAR EACTIONS. M.Sano, S.Yoshida and T.Terasawa. Nuclear Phys., Vol. 6, No. 1, 20-33 (March [2], 1958).

The elastic and inelastic scattering of nucleons by nuclei are nvestigated taking account of the direct and compound processes. 'irst, a few channels are chosen which are strongly coupled to the ntrance channel and a potential matrix is introduced, which des- ribes the interaction among chosen channels and the distortion of he wave in each channel. Then the transition matrix element is 'ritten as a sum of two contributions, one from the direct process nd the other from the compound process. The average cross- ection is also divided into two parts, and the interference term anishes by a suitable choice of the potential matrix. The cross- ection of the direct process has a stronger energy dependence than he single-particle resonance behaviour. The compound cross- ection, which is the contribution from nearby levels and can be alculated if the potential matrix is known, is shown to have the form f the conventional statistical model with a modified definition of the ransmission factor. A.

539.17 : 539.14

286. RELATION OF SCATTERING PHASES TO INTERACTION 'ARAMETERS. E.van der Spuy and H.J.Pienaar. Nuclear Phys., Vol. 7, No. 4, 389-96 (July [1], 1958).

An analysis is introduced which relates the parameters of suit- ble functions of experimental scattering phases, in the presence of :oulomb forces, to parameters which define the nuclear interaction. A feature of the analysis is to circumvent the need for the trouble- ome continuous bivariate interpolation of the Coulomb functions, nd requires instead the knowledge of a number of coefficients which re functions of one nuclear parameter which assumes only certain iscrete values, corresponding to nuclear quantities (such as charge, educed mass, and outer nuclear radius) which need in practice be ied only at discrete values. A further advantage of the analysis is he direct relation which it establishes between experimental phase arameters and the nuclear interaction parameters. A.

539.17

287. ELECTROMAGNETIC EXCITATION OF NUCLEI BY UCLEAR PROJECTILES AND ELECTRONS. R.Huby. ep. Progr. Phys., Vol. 21, 59-111 (1958).

The principles of the excitation of nuclei by their electromagnetic nteraction with bombarding particles are developed in a common ay for electrons and nuclear projectiles. Thereafter these two ypes of projectile are deal with separately, first as regards theory nd then the experimental method. A.

539.17

288. EMISSION OF PARTICLES FROM EXCITED NUCLEI. .Z.Maksimov. h. éksper. teor. Fiz., Vol. 33, No. 6(12), 1411-16 (1957). n Russian.

A formula for dependence of the cross-section of a nuclear eaction involving emission of several particles on the energy of the ncident nuclei is obtained on basis of the statistical theory of nuclei nd Bohr's concept of nuclear reactions. The formula is used to com- ute the cross-sections for nuclear reactions involving emission of , 2, 3 or 4 neutrons from Bi^{209} and I^{127} when the impinging particles re p, d or α-particles. The dependence of entropy of the nucleus on xcitation energy and mass number was determined on basis of the as nuclear model. The results of calculations agree satisfactorily ith the experimental data. A.

539.17 : 530.145

6289. DETERMINATION OF THE PHASES OF THE MATRIX ELEMENTS OF THE S-MATRIX. V.N.Gribov. Zh. éksper. teor. Fiz., Vol. 33, No. 6(12), 1431-6 (1957). In Russian.

For reactions involving two or three channels, or reactions of formation of three low-energy particles it is shown how the phase-shifts of the S-matrix elements can be expressed in terms of measurable quantities by making use of unitarity of the S-matrix and invariance of the theory with respect to time-inversal. The reactions $\tau^+ \to 2\pi^+ + \pi^-$ and $p+p \to D+\pi^+$ are considered. A.

539.17

NUCLEAR REACTIONS DUE TO COSMIC RAYS. See also under "Cosmic rays". Decimal classification 537.591.8

539.17 : 537.534.8 : 537.533.8

ELECTROMAGNETIC RADIATION IN HIGH-ENERGY NUCLEAR INTERACTIONS. See Abstr. 5966

539.17 : 537.534.8

6290. BEAMS OF DIFFERENT MASSES IN ELECTROSTATIC ACCELERATORS. S.L.Andersen, K.Gjötterud, T.Holtebekk and O.Lönsjö. Nuclear Phys., Vol. 7, No. 4, 384-8 (July [1], 1958).

In experiments with protons accelerated in electrostatic generators, the proton energy range may be extended towards lower values by the use of H_2^+ and H_3^+ ions. It is also an accepted practise to check the voltage scale of the generator by comparing the voltage values for which the same reaction is found to take place when beams of different masses are used. The authors compared the use of the H^+ and H_2^+ beams in a series of experiments, and found some discrepancy in the results obtained. The use of the H_2^+ beam to obtain yield curves for (p,γ) reactions is shown to introduce an additional energy spread of about 0.5 keV at 500 keV proton energy. A simple explanation of this effect is suggested. It is also found that the use of the H_2^+ beam leads to lower values for the resonance energies. Resonance energies and upper limits for the half-widths are given for three resonances in the $Al^{27}(p,\gamma)\,Si^{28}$ reaction. A.

539.17

6291. THE (p,α) REACTION ON DEFORMED NUCLEI. D.Chlebowska. Bull. Acad. Polon. Sci. Sér. Sci. math. astron. phys., Vol. 6, No. 3, 199-201 (1958).

There is experimental evidence for the presence of direct interactions in (p,α) reactions. The cross-section for this reaction on deformed nuclei was calculated using Born's approximation and neglecting Coulomb interactions.

A.E.I. Research Laboratory

539.17

6292. ANGULAR DISTRIBUTION AND EFFECTIVE CROSS-SECTION OF THE REACTION $Li^7(p,\alpha)\alpha$ BELOW 600 keV. B.Conrad, V.König and U.Timm. Naturwissenschaften, Vol. 45, No. 9, 204-5 (1958). In German.

The excitation function for this reaction was remeasured with better accuracy using CsI scintillation counters at 0^0 and 90^0. Both the cross-section and the angular anisotropy

$$\frac{\sigma(0,E)}{\sigma(90,E)} - 1,$$

which are represented graphically, show a smooth variation over the range from 125 to 600 keV in contrast to the resonance-like fluctuations found in earlier measurements, which are presumably to be ascribed to a considerable over-estimation of the accuracy of the energy-determinations. P.K.Kabir

539.17

6293. THE SPECTRUM OF NEUTRONS FROM THE REACTION $p + d \longrightarrow p + p + n$. A.T.G.Ferguson and G.C.Morrison. Nuclear Phys., Vol. 5, No. 1, 41-6 (Jan., 1958).

The continuous neutron spectrum from the disintegration of deuterium by protons was measured for proton energies of 3.52, 3.72, and 3.92 MeV. These results are compared with the predictions of the theory of Frank and Gammel (Abstr. 4933/1954). A.

539.17 : 539.12

6294. POLARIZATION OF $Li^7(p,n)Be^7$ NEUTRONS. H.R.Striebel, S.E.Darden and W.Haeberli. Nuclear Phys., Vol. 6, No. 2, 188-95 (March [3], 1958).

The polarization of neutrons emitted from the $Li^7(p,n)Be^7$

reaction at an angle of 50° was measured for neutron energies between 0.7 and 1.5 MeV. The polarization was deduced from the right—left asymmetry in the scattering of these neutrons from liquid oxygen. The results indicate that the polarization is close to −0.3, independent of bombarding energy. One measurement for neutrons emitted at 30° yields a polarization only slightly smaller than for neutrons emitted at 50° for the same proton energy. The total neutron cross-section of oxygen was re-measured for neutron energies between 0.7 MeV and 1.4 MeV. A.

539.17 : 539.12

6295. INELASTIC SCATTERING OF 185 MeV PROTONS ON ELEMENTS BETWEEN Ca AND Zn. H.Tyrén and T.A.J.Maris.
Nuclear Phys., Vol. 7, No. 1, 24-6 (June [1], 1958).

Results at two angles for each of eight elements between V and Zn are presented and show the same features as earlier work on different elements. E.J.Burge

539.17

6296. COINCIDENCE STUDIES OF THE $Ni^{58}(p,2p)$ REACTION. B.L.Cohen.
Phys. Rev., Vol. 108, No. 3, 768-73 (Nov. 1, 1957).

The $Ni^{58}(p,2p)$ reaction was studied by detecting the two outgoing protons in coincidence. Measurements were made of the energy spectra of all protons from the reaction, of the spectrum of the sum of the energies of the two outgoing protons, and of the angular correlations of the outgoing protons with each other and with the incident proton. The results indicate quite conclusively that the preponderance of (p,2p) over (p,pn) reactions in Ni^{58} is not due to the relative level densities of the final nuclei, the ineffectiveness of Coulomb barriers, or a high emission energy of the "first" proton leaving emission of a neutron energetically forbidden. Other possible explanations are considered. There is strong evidence that the (p,2p) reaction mechanism is predominantly a direct one in which the two protons are "knocked-out" simultaneously. A.

539.17

6297. ANOMALOUS BEHAVIOR OF $Al^{27}(p, \alpha)Mg^{24}$ DIFFERENTIAL CROSS SECTIONS.
G.E.Fischer, V.K.Fischer, E.A.Remler and M.D.Tatcher.
Phys. Rev., Vol. 110, No. 1, 286-7 (April 1, 1958).

Angular distribution and energy dependence of the cross-section (measured at 45° laboratory angle) are presented for energy of bombarding proton between 10 and 11 MeV. Butler's (Abstr. 5608/1957) theoretical curve is too much peaked forward to fit the differential cross-section. The authors emphasize the sharp energy dependence. J.Lascoux

539.17

6298. SCATTERING OF 220 MeV POLARIZED PROTONS BY COMPLEX NUCLEI. E.M.Hafner.
Phys. Rev., Vol. 111, No. 1, 297-312 (July 1, 1958).

Extending earlier measurements, yields and asymmetries in the scattering of a highly polarized proton beam by Be^9, C^{12}, Al^{27}, and Ca^{40} were studied. In the work on Be^9 and Al^{27}, the beam was monochromatized through the use of a regenerative deflector; its mean energy on striking the targets was 219.6 MeV, and its standard deviation in energy (including the effect of short time fluctuations) was less than 1.1 MeV. With this technique, together with a refined procedure for the analysis of the distribution in range of scattered protons, it was possible to separate elastic from inelastic scattering in Be^9 at angles from 8° to 37.5°, and to estimate the inelastic scattering involving the excited state at 2.4 MeV. The separation of elastic scattering in Ca^{40} could also be made, although the regenerator was not used. The results are compared with approximate calculations based on the optical model with σ-L coupling; a potential is found such that, with variation of the nuclear radius alone, good fits are obtained to measurements on the four nuclei. A.

539.17

6299. α-PARTICLES EMITTED BY HEAVY NUCLEI IN EMULSIONS UNDER THE ACTION OF HIGH-ENERGY PROTONS. P.A.Vaganov and V.I.Ostroumov.
Zh. éksper.teor. Fiz., Vol. 33, No. 5(11), 1131-9 (1957).
In Russian.

The energy spectra of α-particles emerging from heavy nuclei in emulsions under the action of protons of 360, 560 and 660 MeV energy were investigated at different energies of excitation of these nuclei. The results of calculation of the evaporation spectrum showed satisfactory agreement with experiment in the α-particle energy range up to 14 MeV without resorting to the LeCouteur hypothesis on the lowering of the Coulomb barrier. By subtracting the calculated spectrum of evaporation from the experimental one, the energy distribution of cascade α-particles and their relative number per star for all three energies of the experiment were obtained. A

539.1

6300. KNOCK-OUT OF DEUTERONS FROM Li, Be, C AND O NUCLEI BY PROTONS OF 675 MeV ENERGY.
L.S.Azhgirei, I.K.Vzorov, V.P.Zrelov, M.G.Meshcheryakov, B.S.Neganov and A.F.Shabudin.
Zh. éksper. teor. Fiz., Vol. 33, No. 5(11), 1185-95 (1957).
In Russian.

Momentum spectra of charged particles emitted on bombardment of deuterium, lithium, beryllium, carbon and oxygen by proton of 675 MeV energy were obtained by the method of magnetic analysi at an angle of 7.6° to the proton beam. A group of deuterons of energy about 600 MeV is found to be emitted for all elements. In the case of deuterium, the source of fast deuterons is elastic p—d scattering; in the remaining cases, deuterons are emitted in the reaction $p + (Z,A) \rightarrow d + p + (Z-1, A-2)$, which is proton scattering on quasi-deuteron groups inside nuclei. With an accuracy of about 20%, the differential cross-sections of this reaction are 2.9, 2.2, 3.7 and 4.6×10^{-27} cm^2/sterad for Li, Be, C and O respectively. For the same nuclei, the mean energy of motion of th quasi-deuteron groups is evaluated at approximately 8, 11, 14 and 14 MeV. In the high-momentum part of the spectra, no perceptible quantities of knocked-out tritium nuclei were detected. The experiments that were carried out show that in the passage of nucleons of a given energy through light nuclei, an essential role is played by the processes of three-particle interaction which are accompanied by large momentum transfer to the deuterons. The results obtained are in accord with the concepts that underlie the high-momentum model of the nucleus. A

539.17

6301. A STUDY OF THE EXCITED STATES OF B^{10}. J.Genin.
C.R. Acad. Sci. (Paris), Vol. 246, No. 7, 1028-31 (Feb. 17, 1958).
In French.

The neutrons emitted by a beryllium target under bombardment with deuterons of energy 0.695 keV and 0.570 keV were studied usin the photographic plate method. Neutron groups corresponding to the production of B^{10} in its first five excited states are reported. L.L.Green

539.1

6302. ANGULAR DISTRIBUTIONS OF ELASTICALLY AND INELASTICALLY SCATTERED DEUTERONS FROM NEON. I.J.van Heerden.
Nuclear Phys., Vol. 6, No. 1, 55-61 (March [2], 1958).

The elastic and inelastic differential scattering cross-sections of deuterons from Ne^{20} were measured using nuclear emulsions. The angular distribution of the deuterons inelastically scattered from the 1.63 MeV level, was compared with the predictions of the nuclear and electrical interaction theories of deuteron scattering. A.

539.17

6303. SHAPE EFFECTS IN DEUTERON STRIPPING ON SPHEROIDAL NUCLEI. J.Sawicki and G.R.Satchler.
Nuclear Phys., Vol. 7, No. 3, 289-95 (June [3], 1958).

The geometrical effect of the spheroidal shape of strongly deformed nuclei on the angular distributions from deuteron strippin reactions is discussed. The usual boundary conditions are assumed not on a Butler sphere of radius r_0, but rather on a corresponding spheroidal boundary. This gives rise to contributions to the reaction amplitude, additional to the "spherical" parts, which correspond to angular momenta L different in general from the orbital angular momentum l of the captured nucleon. They do not, however, violate the strong coupling model selection rule $L \geq |K_f - K_i| - \frac{1}{2}$; in particular $L = 0$ can only occur if $|K_f - K_i| = \frac{1}{2}$. These shape contributions are in general rather small, but must be considered when attempts are made to correlate experimental widths with the nuclear collective model and to detect small configuration mixing effects. A

539.17

6304. SPALLATION—FISSION COMPETITION IN HEAVIEST ELEMENTS: TRITON PRODUCTION.
W.H.Wade, J.Gonzalez-Vidal, R.A.Glass and G.T.Seaborg.
Phys. Rev., Vol. 107, No. 5, 1311-13 (Sept. 1, 1957).

Stacked foils of Au^{197}, Th^{232}, and U^{238} were bombarded, in a seri of experiments, with 48 MeV helium ions, 24 MeV deuterons, and 32 MeV protons. Tritium from each foil was collected and then

easured by a gas-counting technique. The qualitative results indiate that high-energy tritons are emitted in relatively large abundnce from all targets and with each of the bombarding particles. ross-sections for triton production from fissionable U^{238} and Th^{232} nd from nonfissionable Au^{197} are comparable. The integrated (α,t) ross-sections thus determined for U^{238} and Th^{232} are nearly the ame as the integrated cross-sections for the "$(\alpha,p2n)$" reactions s determined by measuring the yield of the product heavy isotopes n radiochemical experiments. All of the facts are consistent with a icture of emission of high-energy tritons (whether due to a stripping, ickup, or other mechanism) in which fissionable intermediate nuclei re formed mainly at levels of excitation below their fission threshlds. A.

539.17 : 539.12

6305. POLARIZATION OF PROTONS FROM THE d—d REACTION .T 1.2 MeV. B.Maglić and J.Vuković.
Nuclear Phys., Vol. 6, No. 3, 443-5 (April [1], 1958).

This is measured to be +24 ± 8% at laboratory angle of 135°. he polarization thus appears to depend little on energy between .3 and 1.2 MeV. R.J.N.Phillips

539.17

6306. CALCULATION OF THE $O^{16}(d,p)O^{17}$ ANGULAR ISTRIBUTION. J.L.Richter and E.V.Ivash.
Phys. Rev., Vol. 111, No. 1, 245-9 (July 1, 1958).

Results of calculations based on the Tobocman theory are resented for the angular distribution of the outgoing protons roduced by the $O^{16}(d,p)O^{17}$ stripping reaction in which the residual ucleus is left either in the ground state or in the first excited tate, and for incident energies well below the Coulomb barrier. A variety of nuclear models are examined, including the optical nodel, and the theoretical distributions compared with experimental nes. A.

539.17

6307. ANGULAR DISTRIBUTIONS OF TRITONS FROM THE $^{14}(d,t)C^{13}$ REACTION.
V.E.Moore, J.N.McGruer and A.I.Hamburger.
Phys. Rev. Letters, Vol. 1, No. 1, 29-30 (July 1, 1958).

C^{14} was irradiated by 14.8 MeV deuterons and the angular disributions of tritons leading to the first four levels in C^{13} were easured using a CsI(Tl) detector and six channel pulse-height nalyser. The experimental points were fitted to curves predicted rom Butler theory (Abstr. 442/1952) and the values of the stripping educed widths giving best fits were found. The absolute cross-ections for each level were also calculated.
A.E.I. Research Laboratory

539.17

6308. INVESTIGATION OF THE REACTIONS $K^{39}(d,p)K^{40}$ AND $a^{40}(d,p)Ca^{41}$. I.B.Teplov and B.A.Yur'ev.
Zh. éksper teor. Fiz., Vol. 33, No. 6(12), 1313-20 (1957). In Russian.

Nuclear emulsions were employed to study the angular istributions of three proton groups from the $K^{39}(d,p)K^{40}$ reaction ue to 4.0 MeV deuterons and also of the long-range proton group rom the $Ca^{40}(d,p)Ca^{41}$ reaction due to 1.3, 2.2 and 4.0 MeV euterons. The measured angular distributions do not agree with hose computed from Butler's theory. Comparison of the results btained for the two investigated reactions permits one to draw ome conclusions regarding the lower states of the K^{40} nucleus. A.

539.17 : 539.12

POLARIZATION MEASUREMENTS ON D + D AND T + D EUTRONS. See Abstr. 6151

539.17

6309. THE NUCLEAR REACTION $He^4(\alpha,p)Li^7$ AND ITS INVERSE. . THE REACTION $He^4(\alpha,p)Li^7$.
V.E.Burcham, G.P.McCauley, D.Bredin, W.M.Gibson, D.J.Prowse nd J.Rotblat.
Nuclear Phys., Vol. 5, No. 1, 141-8 (Jan., 1958).

Differential cross-section for the reaction $He^4(\alpha,p)Li^7$ in its round and first excited state were measured for an alpha-particle nergy of 38.5 MeV. The cross-sections are in fair agreement with hose predicted from the yield of the inverse reaction $Li^7(p,\alpha)He^4$. Under certain simplifying assumptions the partial inelastic cross-ections for s- and d-waves in the reaction $He^4(\alpha,p)Li^7$ are 1 ±1 and 33 ± 3 millibarns respectively for the stated incident nergy. A.

539.17

6310. THE NUCLEAR REACTION $He^4(\alpha,p)Li^7$ AND ITS INVERSE. II. THE REACTION $Li^7(p,\alpha)He^4$.
J.M.Freeman, R.C.Hanna and J.H.Montague.
Nuclear Phys., Vol. 5, No. 1, 148-9 (Jan., 1958).

The absolute differential cross-section for the $Li^7(p,\alpha)He^4$ reaction at 90° was measured for a number of proton energies between 1 and 1.5 MeV for comparison with results on the inverse reaction $He^4(\alpha,p)Li^7$. A.

539.17 : 539.14

6311. THE INTERACTION OF TWO ALPHA-PARTICLES.
E.van der Spuy and H.J.Pienaar.
Nuclear Phys., Vol. 7, No. 4, 397-410 (July [1], 1958).

It is investigated whether the phase-shift data for alpha—alpha scattering up to bombardment energies ≈ 6 MeV can be represented by a velocity-independent alpha—alpha interaction potential, or a two-body interaction. It is found on the basis of square-well potentials and of a general purely phenomenological analysis, which is here developed for interactions with an infinite repulsive core, that this is not possible even for this low-energy domain. The results indicate, however, that an outer interaction radius $\approx 4 \times 10^{-13}$ cm with a strong repulsive core of radius $\approx 1.8 \times 10^{-13}$ cm is required. These dimensions are in line with fundamental group resonance calculations of the alpha—alpha interaction starting from nucleon—nucleon forces, which also indicated that the repulsive core of the interaction is velocity-dependent. This velocity-dependence may, for example, be phenomenologically indicated by a lower effective repulsive core radius for higher l. A.

539.17

6312. REACTION MECHANISM IN $F^{19}(\alpha,p)Ne^{22}$ AT 6 MeV.
G.F.Pieper and N.P.Heydenburg.
Phys. Rev., Vol. 111, No. 1, 264-71 (July 1, 1958).

Angular distributions of protons corresponding to the ground-state and first excited-state transitions in the reaction $F^{19}(\alpha,p)Ne^{22}$ were measured for five bombarding energies in the region of 6.0 to 6.55 MeV. Angular correlations of the de-excitation gamma-ray from the first excited state of Ne^{22} with the alpha-particle and proton directions were measured for six different combinations of bombarding energy and proton detection direction. Some, but not all, of the results show striking agreements with predictions based on simple direct-interaction mechanisms. A.

539.17

6313. ELASTIC SCATTERING OF ALPHA PARTICLES BY CARBON-14. J.A.Weinman and E.A.Silverstein.
Phys. Rev., Vol. 111, No. 1, 277-83 (July 1, 1958).

The elastic scattering of alpha-particles by C^{14} was observed for alpha energies between 2.0 and 3.9 MeV and for $\theta_{c.m.}$ = 169°, 149.5°, 140.8°, 125.3°, and 90°. The solid targets of 38.6% C^{14} were at least 8 keV thick. Energies of both the incident and scattered particles were measured with cylindrical electrostatic analysers. The off-resonance cross-sections were normalized to those derived from dispersion theory. Dispersion formalism applied to $C^{14}(\alpha,\alpha)C^{14}$ and $C^{14}(\alpha,n)O^{17}$ data yields the resonance energies, angular momenta, parities and reduced widths of several O^{18} levels. The levels of O^{18} considered had the following resonant energies, parities, and J values: 8.051 MeV (0^+ or 1^-), 8.222 MeV (2^+), 8.293 MeV (3^-), 8.966 MeV ($\geq 2^+$), and 9.0 to 9.2 MeV two levels, either (2^+3^-) or (4^+3^-). A.

539.17 : 539.14

6314. COULOMB EXCITATION OF SEPARATED ISOTOPES OF TIN. D.G.Alkhazov, D.S.Andreev, K.I.Erokhina and I.Kh.Lemberg.
Zh. éksper. teor. Fiz., Vol. 33, No. 6(12), 1347-58 (1957). In Russian.

Alpha-particles accelerated in a cyclotron to an energy of 14.5 MeV were used to investigate Coulomb excitation of the nuclear levels of separated isotopes of tin. A number of previously unknown states were excited, for which the values of energy and of the reduced probability of transition from the ground state were measured. The lifetimes of the first excited states of even—even isotopes of tin have been calculated. The lifetimes lie within the limits 5×10^{-13} sec (Sn^{114}) to 16×10^{-13} sec (Sn^{124}). A.

539.17

6315. NUCLEAR COLLISION STOPPING OF ASTATINE ATOMS.
R.B.Leachman and H.Atterling.
Ark. Fys., Vol. 13, Paper 9, 101-8 (1957).

The ranges and range stragglings of astatine atoms stopped in aluminium and in silver were measured. The reactions $Au^{197}(C^{12},xn)At$ were used to provide astatine atoms with velocities near the Bohr velocity v_0, for which stopping is principally by

nuclear collisions. The results are consistent with calculations involving an assumed potential of the screened field decreasing as r^{-2} from the nucleus for nuclear collisions. A.

539.17

6316. EXPERIMENTS TO OBTAIN ELEMENT 102. G.N.Flerov, S.M.Polikanov, A.S.Karamyan, A.S.Pasyuk, D.M.Parfanovich, N.I.Tarantin, V.A.Karnaukhov, V.A.Druin, V.V.Volkov, A.M.Semchinova, Yu.Ts.Oganesyan, V.I.Khalizev and G.I.Khlebnikov.
Dokl. Akad. Nauk SSSR, Vol. 120, No. 1, 73-5 (1958). In Russian.

Plutonium isotopes Pu^{239} and Pu^{241} were irradiated with oxygen ions, accelerated to 102 MeV. The nucleus so produced leaves the target, because of recoil, and is picked up in a collector. This can be moved, in a time of 4-5 sec, over to nuclear emulsions which are designed to register α-particles. Alpha-particles of energy greater than 8.5 MeV are detected. These could come from $Pu^{239,241}(O^{16},4\text{-}6n)102^{251-253}$. The total number of α-particles with an energy exceeding 8.5 MeV (those of energy less than 7 MeV could come from platinum contamination) was 18 in the irradiation of Pu^{241} and 8 in the case of Pu^{239}. These figures would give cross-sections for formation of element 102 of 2×10^{-32} and 5×10^{-33} cm^2, respectively. G.E.Brown

539.17

6317. NUCLEAR REACTIONS OF N^{14} IONS WITH Li^7 AND C^{12}. D.G.Alkhazov, Yu.P.Gangrskiĭ and I.Kh.Lemberg.
Zh. éksper. teor. Fiz., Vol. 33, No. 5(11), 1160-2 (1957). In Russian.

In an investigation of the reaction products of bombardment of Li^7 by nitrogen ions accelerated to 15.6 MeV, activities of F^{18}, Ne^{19}, N^{16} and O^{15} were detected, and in bombardment of graphite, Al^{28} activity. The production cross-sections of the above-mentioned reaction products were determined. On comparison of the magnitudes of production cross-sections of F^{18} in bombardment of various light elements with nitrogen ions with the values of the binding energy of α-particles in these nuclei, it is suggested that formation of F^{18} occurs by means of the incident N^{14} nucleus capturing an α-particle out of the nucleus. A.

539.17 : 539.14

ENERGY LEVEL SPECTRUM OF C^{15} FROM THE NUCLEAR REACTION $Be^9(Li^7,p)C^{15}$. See Abstr. 6226

539.17

6318. ELECTRON SCATTERING BY POLARIZED NUCLEI. R.G.Newton.
Phys. Rev., Vol. 109, No. 6, 2213-14 (March 15, 1958).

Nuclear magnetic moment distributions can be investigated by electron scattering experiments with polarized nuclei. Previous calculations of cross-sections (Abstr. 6703/1956) assumed the magnetic moment direction to be fixed; this restriction is now removed. R.J.N.Phillips

539.17

6319. PHOTODISINTEGRATION OF OXYGEN. S.A.E.Johansson and B.Forkman.
Ark. Fys., Vol. 12, Paper 16, 359-80 (1957).

The (γ,p) and (γ,α) reactions in O^{16} were studied. Oxygen gas was irradiated in the bremsstrahlung beam of a 35 MeV synchrotron. The photoprotons were recorded by nuclear emulsions. Three different maximum bremsstrahlung energies were used: 20.5, 23, and 26 MeV. The low-energy irradiation gives a proton spectrum containing well resolved peaks. They are attributed to transitions from resonances in O^{16} to the ground state of N^{15}. There is a very good agreement with the breaks found in the activation curve of the (γ,n) reaction. The information about the resonances in the low-energy region is then used to analyse the proton spectrum at the medium energy. Finally, the proton spectrum at the highest irradiation energy is analysed by means of the information from the other two irradiations. In this way it is possible to resolve the proton spectra in transitions from various resonances or groups of resonances in O^{16} to the ground state and the excited states of N^{15}. The angular distributions of the strongest proton groups were studied. The information about the photodisintegration of O^{16} obtained in the present work is compared with the predictions of the various models proposed to explain the photodisintegration. Below the threshold of the (γ,p) reaction the photodisintegration of O^{16} was studied by investigating the (γ,α) reaction. Nuclear emulsions were soaked in water in order to increase the oxygen content and then irradiated directly in the synchrotron beam. The α-tracks from the photodisintegration of oxygen were identified by the short, heavily ionized track of the recoiling daughter nucleus. The α-particle spectrum shows two groups corresponding to levels in O^{16} at 11.3 and 12.5 MeV. This result is compared with the theoretical calculations based on α-particle model for O^{16}. The agreement with the theory is very good.

539.

6320. DETERMINATION OF PHOTONUCLEAR CROSS SECTION J.H.Carver and K.H.Lokan.
Austral. J. Phys., Vol. 10, No. 2, 312-19 (June, 1957).

Assuming the theoretical bremsstrahlung spectrum for fast electrons incident on a thin radiator, an iterative method is formulated for deriving the photonuclear cross-section as a function of γ-energy from the measured curve of yield against maximum bremsstrahlung energy. Tables are provided to enable the numerical differentiation of the experimental curve to lead to a converging solution of the cross-section curve by successive approximation. The method is applied to the positron yield from the $C^{12}(\gamma,n)C^{11}$, $O^{16}(\gamma,n)O^{15}$ and $Fe^{54}(\gamma,n)Fe^{53}$ reactions, and the deduced cross-sections from threshold to 31 MeV are given. A.E.I. Research Laborato

539.1

6321. THE CROSS-SECTION FOR THE $^{16}O(\gamma,n)^{15}O$ REACTION. B.M.Spicer.
Austral. J. Phys., Vol. 10, No. 2, 326-9 (June, 1957).

The existence of structure within the giant resonance is investigated by measuring the yield curve for the $O^{16}(\gamma,n)O^{15}$ reaction as a function of the betatron energy (Abstr. 1582/1956) (steps of approximately 0.2 MeV from threshold to 25 MeV). The yield curv is then solved (Penfold and Spicer, Phys. Rev., Vol. 95, 637, 1954) for cross-section without any smoothing, first in steps of 1 MeV, then, of 0.5 MeV. Below 20 MeV, the two curves are in agreement with the previous fine structure measurement (Abstr. 1582/1956). But the 0.5 MeV curve exhibits now, even above 20 MeV, a structure not present in the 1 MeV solution. J.Lascou

539.1

6322. ON THE LONG-RANGE CORRELATION MODEL OF THE PHOTONUCLEAR EFFECT. M.Danos.
Nuclear Phys., Vol. 5, No. 1, 23-32 (Jan., 1958).

The long-range correlation model, i.e. the hydrodynamic "second-sound" model, of the photonuclear effect (X-ray absorptio predicts a splitting of the giant resonance in deformed nuclei. As result of this, the width and the shape of the observed resonance will be different in different nuclei. The hydrodynamic model further predicts the existence of a second-sound monopole mode at roughly twice the energy of the dipole mode. However, the resonance energy is so high that this mode may be damped completely except, perhaps, in the heaviest nuclei. Observation of this mode could yield information about the energy dependence of the friction coefficient Γ of second sound in nuclear matter. A

539.1

6323. MEASUREMENTS OF (γ,d) AND (γ,np) REACTIONS IN TH THRESHOLD REGION. J.Goldemberg and L.Marquez.
Nuclear Phys., Vol. 7, No. 2, 202-8 (June [2], 1958).

The yield of the combined nuclear reactions (γ,d) and (γ,np) w measured for Zn^{64}, Zn^{66}, Fe^{54} and S^{32} by isolating and measuring th activity of the residual nucleus. In the first two cases a curve with two peaks was found for the cross-section. In the third case, no residual activity was found and an upper limit is given for the yield In the fourth case the results found coincide with the results of other workers who had measured this reaction. A

ATOMS

539.1

6324. TIME-OF-FLIGHT MEASUREMENT OF PHOTONEUTRON ENERGY SPECTRA. W.Bertozzi, F.R.Paolini and C.P.Sargent.
Phys. Rev., Vol. 110, No. 3, 790-1 (May 1, 1958).

The photoneutron energy spectra produced by irradiating bismuth, gold and tantalum with bremsstrahlung of maximum energies 14.3 MeV and 15.8 MeV from a pulsed electron linear accelerator were measured by a time-of-flight technique using plastic scintillator detectors. The neutron spectra, if due to the decay of a compound nucleus indicate relative level densities of ea nucleus which are not in agreement with that predicted from the degenerate Fermi gas models. A.E.I. Research Laboratory

539.17

6325. PHOTODISINTEGRATION OF THE DEUTERON IN THE MEDIUM ENERGY RANGE. J.J.de Swart and R.E.Marshak.
Phys. Rev., Vol. 111, No. 1, 272-6 (July 1, 1958).

This is calculated using the Gartenhaus wave-function for the deuteron and the Gartenhaus plus spin—orbit wave-functions for the final states. The results are in agreement with experiment. It is shown that the cross-sections are sensitive to the triplet odd scattering phase-shifts and the D-state probability, but rather insensitive to the detailed shapes of the wave-functions. The results indicate that it is not necessary to relinquish Siegert's theorem in order to explain the large isotropic term in the angular distribution in this energy region, provided one assumes a rather high percentage of D state (7%) for the ground state of the deuteron. A.

539.17

6326. THE YIELD AND ANGULAR DISTRIBUTION OF FAST PHOTONEUTRONS FROM DEUTERIUM AND CARBON.
P.S.Baranov, V.I.Gol'danskiĭ and V.S.Roganov.
Zh. éksper. teor. Fiz., Vol. 33, No. 5(11), 1123-30 (1957). In Russian.

The yield and angular distribution of fast photoneutrons (of energy > 20 MeV) from carbon and deuterium were investigated using a 265 MeV synchrotron. The results of experiments at photon energies both below and above the threshold for meson production are interpreted in terms of the two-nucleon model. A.

539.17

6327. STUDY OF THE REACTIONS (n,α) AND (n,t) ON Be^9.
S.S.Vasil'ev, V.V.Komarov and A.M.Popova.
Dokl. Akad. Nauk SSSR, Vol. 119, No. 5, 914-17 (1958). In Russian.

These reactions were studied in the energy range from 1 to 19 MeV in nuclear emulsions filled with beryllium powder. Neutrons were obtained from a lithium target irradiated with deuterons. Total cross-sections and angular distributions are given.

G.E.Brown

539.17 : 539.14

6328. AN ANALYSIS OF SLOW NEUTRON RESONANCES IN SILVER. E.R.Rae, E.R.Collins, B.B.Kinsey, J.E.Lynn and E.R.Wiblin.
Nuclear Phys., Vol. 5, No. 1, 89-121 (Jan., 1958).

The spins, radiation widths and neutron widths of ten levels in Ag^{108} and Ag^{110} were determined from the measurement of total, elastic scattering and radiative capture cross-sections for slow neutron resonances with silver, in the range of neutron energy from 1 eV to 135 eV. The experimental measurements are described. The results of these measurements are combined by a least-square method of analysis to obtain an unambiguous assignment of level spin (J) and to derive values for the radiation and neutron widths. Seven levels are found to have J = 1 and three to have J = 0. The radiation widths appear to be approximately equal in both isotopes and to be independent of the level spins, J = 0 or 1. The theoretical implications of these results are briefly discussed. A.

539.17

6329. INVESTIGATION OF THE $B^{10}(n,\alpha)Li^7$ REACTION BY THE PHOTOEMULSION METHOD. E.Bujdosó.
Nuclear Phys., Vol. 6, No. 1, 107-13 (March [2], 1958).

Nuclear emulsion Agfa K3 (loaded with boron) was exposed to slow neutrons. By measuring the range $R(\alpha + Li^7)$, values $Q^* = 2.29 \pm 0.09$ MeV and $Q = 2.76 \pm 0.17$ MeV for the energy of the reaction were obtained. The ratio of decays leading to the ground and excited states of the Li^7 nucleus is

$$\sigma[B^{10}(n,\alpha)Li^7]/\sigma[B^{10}(n,\alpha)Li^{7*}] = 0.086 \pm 0.009.$$

A.

539.17

6330. EFFECTIVE TOTAL CROSS-SECTIONS FOR NEUTRONS WITH ENERGY NEAR 14 MeV. J.F.Vervier and A.Martegani.
Nuclear Phys., Vol. 6, No. 2, 260-70 (March [3], 1958). In French.

The total cross-section of C, Mg, Al, Fe, Cu, Pb and U was measured for neutron energies near 14 MeV by transmission experiments with good geometry. The agreement with previous measurements is satisfactory; the general form of total cross-section curves is the same for elements with neighbouring A-values; giant resonances were found for C, Mg and Al. The "strong coupling model" is not valid in this energy region, but the results agree qualitatively with the "intermediate coupling model". A.

539.17

6331. OPTICAL MODEL CALCULATION OF THE INTERACTION OF SLOW NEUTRONS WITH PROLATE NUCLEI.
V.V.Vladimirsky and I.L.Ilyina.
Nuclear Phys., Vol. 6, No. 2, 295-304 (March [3], 1958).

The cross-sections for absorption and scattering of slow neutrons by non-spherical ellipsoidal nuclei are calculated on the basis of the optical model. Diffuseness of the nuclear boundary and rotation of the nucleus are neglected. The results obtained allow one to explain the great width of the giant resonance in the region A = 150. It is shown that in the case of prolate nuclei the main resonances are accompanied by additional maxima. A.

539.17

6332. THE ENERGY DISTRIBUTION OF PROTONS EMITTED IN (n,p) REACTIONS. J.Németh.
Nuclear Phys., Vol. 6, No. 5, 686-90 (May, 1958).

If oscillation of the excited nucleus during evaporation is taken into account, the energy of the emitted protons is different in a system related to the nuclear surface from that in the laboratory system. The energy distribution of the emitted protons is qualitatively in good agreement with the experimental data. The spectra of protons emitted in (n,p) reactions from Rh bombarded by 13.2 MeV neutrons were studied. A.

539.17

6333. SCATTERING OF 14.5 MeV NEUTRONS BY COMPLEX NUCLEI.
J.H.Coon, R.W.Davis, H.E.Felthauser and D.B.Nicodemus.
Phys. Rev., Vol. 111, No. 1, 250-60 (July 1, 1958).

New measurements of the differential elastic scattering cross-sections of C, Al, Fe, Cu, Sn, Pb, and U for 14.5 MeV neutrons are reported. For Fe, Cu, Sn, and Pb the angular range from 5^0 to 150^0 was investigated with $\pm 1^0$ to $\pm 3^0$ angular resolution. For the other elements a smaller angular range was investigated. Particular effort was devoted to the problem of discriminating against inelastically scattered neutrons and methods were developed which provided an experimental energy resolution of ~500 keV. Limited differential cross-section data for inelastically scattered neutrons of energy greater than 9 MeV are also presented for Fe, Cu, Sn, and Pb.

A.

539.17

6334. THE NUCLEAR REACTION $Li^6(n,t)He^4$.
T.I.Kopaleĭshvili.
Zh. éksper. teor. Fiz., Vol. 33, No. 3(9), 788-90 (1957). In Russian.

Assuming Li^6 as a compound of deuteron and alpha particle in an S state, the energy dependence of the total cross-section for this reaction is calculated in Born approximation. The agreement with experiment is satisfactory in the range of neutron energy from 1 to 14 MeV. Below 1 MeV the theory does not apply because of known resonance behaviour. J.W.G.Wignall

539.17

6335. FAST-NEUTRON-INDUCED DISINTEGRATION OF THE C^{12} NUCLEUS INTO THREE α-PARTICLES.
S.S.Vasil'ev, V.V.Komarov and A.M.Popova.
Zh. éksper. teor. Fiz., Vol. 33, No. 6(12), 1321-4 (1957). In Russian.

The energy dependence of the cross-section for three α-particle disintegration of the C^{12} nucleus induced by fast neutrons is investigated from threshold energies up to 19 MeV. Information relating to variations in the mechanism of C^{12} disintegration into three α-particles in the indicated primary neutron energy range is obtained on basis of calculations of the excitation energies of intermediate nuclei involved in the disintegration and of the spatial and energy distributions of the disintegration products. A.

539.17 : 539.14

MEASUREMENT OF THE NEUTRON STRENGTH FUNCTION FOR NUCLIDES WITH 45-75 NUCLEONS. See Abstr. 6220

539.17

6336. POLARIZATION OF THE RECOIL NUCLEUS IN μ^--CAPTURE. T.Fulton.
Nuclear Phys., Vol. 6, No. 2, 319-22 (March [3], 1958).

The complete expression is calculated for the allowed, non-relativistic transition rate of μ^--capture from the atomic K-shell. It is used to obtain the expression for the polarization of the recoil nucleus. The polarization term governs the asymmetry in the subsequent beta decay. If the incident μ are unpolarized, the polarization of the recoil following μ-capture in a Gamow—Teller transition can in principle distinguish between the coupling constants suggested by Lee and Yang (Abstr. 3956/1957) and by Feynman and Gell-Mann (Abstr. 507/1958). A.

539.17

6337. RADIOCHEMICAL STUDY OF PRODUCTS OF THE FISSION OF LANTHANUM BY 660 MeV PROTONS.
A.K.Lavrukhina, L.D.Krasavina and A.A.Pozdnyakov.

Dokl. Akad. Nauk SSSR, Vol. 119, No. 1, 56-8 (1958). In Russian.

The total cross-section for fission is found to be ~0.6 millibarns, the cross-section for the production of separate isotopes (Z = 15 to Z = 40) varying from 1 to 100 microbarns. A detailed table of results is given. W.O.Lock

539.17

6338. ANGULAR CORRELATION BETWEEN THE FRAGMENTS AND CHARGED PARTICLES EMITTED IN THE FISSION OF URANIUM NUCLEI. V.I.Ostroumov and R.A.Filov.
Zh. éksper. teor. Fiz., Vol. 33, No. 6(12), 1335-40 (1957). In Russian.

Fission events induced by 660 MeV protons in uranium nuclei and involving the emission of charged particles were observed in nuclear emulsions. The angular distribution of these particles relative to the direction of the bombarding beam and also relative to the line of flight of the fragments was measured. No angular correlation between the protons and fragments was found although some of the protons may have been emitted by the fission fragments. Alpha-particles and multicharged particles exhibit a tendency to be emitted at large angles with respect to the fragments. Factors which may be responsible for the observed correlation between α-particles and fragments are discussed. A.

539.17

6339. CALORIMETRIC DETERMINATION OF THE AVERAGE TOTAL KINETIC ENERGY OF FRAGMENTS FROM FISSION OF U^{235}. S.R.Gunn, H.G.Hicks, H.B.Levy and P.C.Stevenson.
Phys. Rev., Vol. 107, No. 6, 1642-5 (Sept. 15, 1957).

A value of 166 ± 2 MeV was obtained, in excellent agreement with other measurements. The calorimeter and the method of correction for beta absorption are described. The number of fissions occurring in the samples was determined by a Mo^{99} radiochemical analysis which is described in detail. An improved value for the half-life of Mo^{99}, 66.00 ± 0.15 hr, was determined. A.

539.17

6340. OBSERVATION OF PARTICLES OF CHARGE $Z > 2$ IN FISSIONS PRODUCED IN PHOTOGRAPHIC EMULSION BY HIGH-ENERGY NEUTRONS. V.M.Sidorov and E.L.Grigor'ev.
Zh. éksper. teor. Fiz., Vol. 33, No. 5(11), 1179-84 (1957). In Russian.

Experimental results are reported on particles of charge $Z > 2$ from fissions produced in nuclear emulsions by high-energy neutrons. Neutrons had a broad energy distribution with a maximum in the region of 395 MeV. Measurements of the cross-section for the emission of heavy particles, of their angular and energy distribution and charge distribution were made. A.

539.17

6341. THE "GEOMETRIC BUCKLING" OF SPHEROIDAL NUCLEAR REACTORS. N.G.Sjostrand and A.Rentze.
Ark. Fys., Vol. 13, No. 3, Paper 19, 229-34 (1958).

The Helmholtz equation $\nabla^2\Phi + B^2\Phi = 0$ was solved with the boundary condition $\Phi = 0$ on the surface of a spheroid. The lowest eigenvalue was calculated for prolate and oblate spheroids of different shapes, and comprehensive tables of the "geometric buckling" of spheroidal nuclear reactors are given. A.

539.17

6342. NEUTRON DISTRIBUTION IN THE AIR SPACED CORE ASSEMBLY OF ZEPHYR.
J.E.R.Holmes, M.U.Curry and M.Waldegrave.
Atomic Energy Res. Establ. (Harwell), Rep.R/R1949, 28 pp. (1956).

A description is given of the nuclear reaction rate surveys that were made in the second core assembly of Zephyr. A detailed comparison with the first assembly leads to the following main conclusions. (1) The core neutron spectrum in the air spaced core (Core II) has an average energy of about 1.7 MeV. This is more energetic than the core spectrum of the uranium spaced core (Core I), where the average energy is about 1.5 MeV. (2) Using revised nuclear data, a neutron balance was demonstrated for both assemblies. The breeding ratio for Core II is found to be 1.90 ± 0.15, which is slightly less than the Core I value of 2.00 ± 0.15. (3) The observed delayed neutron fraction, β, is 0.34 ± 0.01% for the Core I assembly and 0.29 ± 0.01% for the Core II assembly. These values are appreciably greater than for Pu^{239} alone (0.23 ± 0.02%) and can be deduced from the fission rate surveys when the variation of neutron effectiveness with energy is taken into account. A.

539.17

6343. LIDO — THE ENGINEERING AND PHYSICS DESIGN. H.R.McK.Hyder, J.W.Weale, A.Green, E.D.Jones, C.J.Kenward and P.J.Oram.
Atomic Energy Res. Establ. (Harwell), Rep. R/R 2340, 20 pp. (1957).

A detailed account is given of the reactor core, the instrumentation, the tank and water treatment plant and the building and services. Also included is a summary of the reactor physics, shielding and heat transfer calculations. A.

539.17

6344. ON A SYNTHETIC METHOD FOR THE ESTIMATION OF THE TOTAL REACTIVITY ABSORBED BY THE CONTROL SYSTEM OF LARGE POWER REACTORS. G.Vacchelli.
Energia Nucleare, Vol. 5, No. 6, 393-7 (June, 1958). In Italian.

The reactor is considered as consisting of elementary cells, each of which has a central absorbing element surrounded by a portion of active core. L.Pincherle

539.17

6345. MEASUREMENT OF THE NEUTRON SPECTRUM FROM ZETA. B.Rose, A.E.Taylor and E.Wood.
Nature (London), Vol. 181, 1630-2 (June 14, 1958).

The energy of neutrons emitted by D(d,n) reactions in Zeta (Abstr. 773-9/1958) was measured with a 18 in. diameter, 110 lb/sq in. diffusion cloud chamber to within 4% per proton recoil track. The mean energy of neutrons emitted in the direction of the Zeta current exceeds by 0.12 ± .03 MeV that found with a standardizing D(d,n) source, and by 0.29 ± .03 MeV that of neutrons emitted at 180^0 to the current. This result conflicts with the hypothesis that the majority of the neutrons are from thermonuclear reactions in a stationary deuterium plasma; it is explicable on the hypothesis that 10^{-6} of the deuterons are directly accelerated by the electric field to an energy of 17 keV. R.S.Pease

539.17 : 536.212.3

HEAT CONDUCTION IN CHARCOAL COLUMNS. See Abstr. 5835.

539.18

6346. OPEN-SHELL ENERGIES OF LITHIUM-LIKE IONS. E.A.Burke and J.F.Mulligan.
J. chem. Phys., Vol. 28, No. 5, 995-6 (May, 1958).

Applies the methods of Abstr. 6091 (1956) and 354 (1958) to the ions Be^+ to F^{6+}. The improvement over closed-shell results decreases with increasing Z because angular correlation becomes more important. J.Hawgood

539.18

6347. NOTE ON THE APPROXIMATION OF TWO-CENTER EXCHANGE INTEGRALS. P.Csavinszky.
J. chem. Phys., Vol. 28, No. 5, 996-8 (May, 1958).

It is shown that the Mulliken approximation is the arithmetic mean of two approximations in which the wave-function centred on one nucleus is expanded in terms of wave-functions centred on the second. The contributions from both approximations are separately tabulated for the case of exchange integrals composed of 1s wave-functions, where the errors in the two approximations largely cancel. M.J.Kearsley

539.18

6348. THE CALCULATION OF THE ELECTRIC FIELD GRADIENT IN ATOMS. V.A.Benderskii and L.A.Blyumenfel'd.
Optika i Spektrosk., Vol. 3, No. 4, 402-5 (1957). In Russian.

Values of q_{at} based on the expression

$$q_{at} = \frac{2l(l+1)}{(2l+3)(2l-1)} \cdot e\left(\frac{2Z_l}{na_0}\right)^3 \cdot \frac{(2n-3)!}{2n!}$$

(where Z_l, n and l, and a_0 are the effective nuclear charge, quantum numbers and Bohr radius, respectively) are compared with experimental values for the atoms with the atomic number Z = 3 to 9, 11 to 17, 19, 20, and 31 to 35. An expression for the polarization effect of the closed electron shells is derived and calculations made for certain of these atoms. L.Bovey

539.18

6349. OPTICAL DETECTION OF MAGNETIC RESONANCE IN ALKALI METAL VAPOR. W.E.Bell and A.L.Bloom.
Phys. Rev., Vol. 107, No. 6, 1559-65 (Sept. 15, 1957).

Two types of r.f. magnetic resonance experiment are discussed, involving optical pumping in alkali vapour, which have recently been suggested by Dehmelt (Abstr. 6470/1957). These experiments are, respectively, observation of a change of intensity at resonance of the transmitted pumping light, and observation of high-frequency intensity modulation in a second light beam (the "cross-beam") incident at an angle to the first. The method of pumping used here is reviewed, together with some of the special assumptions on which it is

based. The function of the light in monitoring population differences is treated as a separate matter from the pumping function; it is shown that the observed changes in transmitted light intensity can be correlated in a simple way with other observables of a spin system, and this leads to a simple explanation of the high-frequency modulation effects. A system of spin-$\frac{1}{2}$ particles subject to optical pumping and monitoring is then treated phenomenologically. The resulting equations have the same form as Bloch's equations except that (1) the time constants must include effects of the incident light, and (2) there is an additional term due to the cross beam which, however, is shown to have no effect on the shape of the resonance. The apparatus is described, together with experimental conditions under which signals were observed. Possible applications of the technique include magnetic-field measurements, and studies of atomic constants of alkali metal isotopes. A.

539.18

6350. GROUND STATE ENERGY OF TWO-ELECTRON ATOMS. CORRECTIVE RESULTS. E.A.Hylleraas and J.Midtdal.
Phys. Rev., Vol. 109, No. 3, 1013-14 (Feb. 1, 1958).

Ground state energies of the He atom and homologous ions reported previously (Abstr. 8936/1956) are found to be in error. The errors are corrected and the final energy value obtained from a 24-parameter variational function, including a nonconventional logarithmic term, is about 0.2 cm^{-1} behind that of Kinoshita for helium. The contribution from the logarithmic term to the energy value for both large and small Z is appreciable, and almost unaffected by the correction, in contrast to the result of Hart and Herzberg. [The earlier energy value for helium, when combined with relativistic and quantum electrodynamic corrections, led to a disagreement between theory and experiment. This is now removed]. P.K.Kabir

539.18

6351. HYPERFINE STRUCTURE MEASUREMENTS ON NEPTUNIUM-239. J.C.Hubbs and R.Marrus.
Phys. Rev., Vol. 110, No. 1, 287-9 (April 1, 1958).

The Zeeman h.f.s. was investigated by the atomic-beam magnetic resonance method, giving six resonances fitting accurately the system J = 11/2, I = 5/2, g_J = 0.6551, probably arising from the ground state $(5f)^4(6d)^1(7s)^2$. This value of nuclear spin agrees with that found by beta- and gamma-spectroscopy but not with the value I = 1/2 from optical and paramagnetic resonance spectroscopy (Abstr. 2077/1955, 5360/1956, 9334/1957). J.Hawgood

539.18 : 539.12

6352. HYPERFINE STRUCTURE OF DEUTERIUM AND NUCLEON–NUCLEON SPIN–ORBIT POTENTIALS.
A.M.Sessler and H.M.Foley.
Phys. Rev., Vol. 110, No. 4, 995-6 (May 15, 1958).

It is pointed out that this provides a sensitive test for any proposed spin–orbit potential. G.H.Burkhardt

539.18

6353. SPHERICAL EIGENFUNCTIONS AND ANGULAR MOMENTUM DISTRIBUTIONS IN THE STATISTICAL THEORY OF ATOMS. S.Golden.
Phys. Rev., Vol. 110, No. 6, 1349-51 (June 15, 1958).

The Thomas–Fermi density is expressed in terms of free-particle eigenfunctions of angular momentum. Expressions are directly obtained for the density of electrons of specified angular momentum. With the angular momentum distribution restricted to zero values, the Fermi–Amaldi theory is utilized to calculate the electron densities in hydrogen and helium. They are in poorer agreement with quantum-mechanical densities than those obtained with the original Fermi–Amaldi theory. The angular momentum distribution for the Thomas–Fermi field is determined for several atomic numbers. In each case, the agreement with "experimental" values is moderate. A.

539.18

6354. TWO-QUANTUM INTERACTION CORRECTION FOR THE GROUND-STATE ENERGY OF THE HELIUM ATOM. M.Günther.
Phys. Rev., Vol. 111, No. 1, 182-7 (July 1, 1958).

A "frozen" potential representing mutual two-quantum interactions of two electrons is derived, starting from the simplest non-relativistic version of quantum electrodynamics. This potential is then used for calculating an energy correction for the ^1S state of the helium atom with the help of wave-functions of the Hylleraas type. A.

539.18

6355. CONFIGURATION INTERACTION IN THE GROUND STATE AND TWO EXCITED STATES $(1s, 2s)\,^1S$ AND $(1s, 3s)\,^1S$ OF He ATOM. B.K.Gupta and V.S.R.Rao.
Proc. Phys. Soc., Vol. 71, Pt 6, 1015-16 (June, 1958).

A slight modification of the (1s, 1s') wave function of Taylor and Parr (Abstr. 5995/1952) enables it to be written in terms of the Hylleraas variables, and slightly improves the ground state energy. Taylor–Parr wave functions are used for the excited states, with good results. J.Hawgood

539.18

6356. ON THE BETHE–SALPETER EQUATION AND THE EXCITED STATES OF THE HYDROGEN ATOM.
H.Kita and M.Wakano.
Progr. theor. Phys., Vol. 17, No. 1, 63-79 (Jan., 1957).

It is shown that the exact Bethe–Salpeter equation does not determine higher excited levels of the hydrogen atom by analysing the asymptotic behaviour of two-particle amplitudes associated with photon coordinates at large distances. An approximate method of treating the problem of excited states is given. Some related problems are also discussed briefly. A.

539.18

6357. A THEORETICAL STUDY OF A MESIC HELIUM ATOM.
M.Demeur and R.Lavalle.
Bull. Acad. Roy. Belgique Cl. Sci., Vol. 43, No. 7, 458-70 (1957).
In French.

The electronic structure of a helium mesic atom was investigated by means of the adiabatic approximation; it is shown that ionization occurs when the meson lies in the region of the electronic K-orbit. Auger effect was studied in the case of an electron moving in the non-central field produced by nucleus and meson; it is pointed out that the transition remains essentially E1. The molecular ion HeH^{++} was investigated by the variational method with trial function $\exp(-\alpha\lambda - \beta\mu)$. A.

539.18

6358. PASCHEN–BACK EFFECT AS A MEANS OF DETECTING MUONIUM. R.A.Ferrell and F.Chaos.
Phys. Rev., Vol. 107, No. 5, 1322-3 (Sept. 1, 1957).

Although formation of muonium (the bound system of a μ^+-meson and an electron) can be expected in suitable materials, the precession test for it has been negative. Since this test is sensitive to slight perturbations it is proposed to substitute for it a more positive and insensitive test which uses a strong magnetic field in the direction of the initial muon orientation rather than a weak field at right angles. In this way the depolarizing effect of the muonium hyperfine coupling is quenched and the beta-decay asymmetry will be increased. The amount of increase determines the fraction of muons forming muonium. For a field of five kilogauss the quenching should be 90% complete. A.

539.18

6359. EFFECT OF THE HYPERFINE SPLITTING OF A μ-MESONIC ATOM ON ITS LIFETIME.
J.Bernstein, T.D.Lee, C.N.Yang and H.Primakoff.
Phys. Rev., Vol. 111, No. 1, 313-15 (July 1, 1958).

The lifetime of a μ-mesonic atom depends on its hyperfine state because of the spin dependence of the interaction between the μ^- meson and the capturing proton. The small lifetime difference between the hyperfine states is estimated in a one-particle model. Possible experimental detection of such a difference is discussed. A.

539.18

6360. MESONIC ATOMS. D.West.
Rep. Progr. Phys., Vol. 21, 271-311 (1958).

The properties of mesonic atoms are described. The information which can be deduced about the properties of the π and μ mesons and their interactions with the nucleus is summarized. Experimental results on the nuclear size, meson masses and the π meson–nucleon interaction, which have been obtained from a study of the energy levels, are discussed. The experimentally determined yields of K and L series X-rays also give information on the processes of de-excitation of mesonic atoms. In particular there is evidence of collision de-excitation which is related to meson transfer in compounds and the formation of mesonic molecules, which is observed in liquid hydrogen. Other properties of mesonic atoms at present beyond the reach of experimental investigation are briefly mentioned. A.

539.18 : 539.12

6361. MASS DIFFERENCE T – He^3 AND THE MASS OF THE NEUTRINO. L.Friedman and L.G.Smith.
Phys. Rev., Vol. 109, No. 6, 2214-15 (March 15, 1958).

The mass difference was obtained from mass synchrometer

measurements. Together with the T beta spectrum, it gives a purely empirical upper limit on the neutrino mass of order 1 keV.
J.C.Taylor

539.18

6362. ON THE PREPARATION OF RADIOACTIVE SAMPLES BY MEANS OF ELECTROMAGNETIC ISOTOPE SEPARATION.
G.Andersson.
Ark. Fys., Vol. 12, Paper 14, 331-51 (1957).

A small electromagnetic isotope separator was constructed with special regard to investigations of synchrocyclotron-produced radioactivities. The requirements put forward, including the simultaneous collection at equal focusing conditions of a large fraction of the mass spectrum, were found to be fulfilled by the parallel beam type of magnetic analyser. A brief review of the basic principles of the apparatus is given. Various measures aiming at increased efficiency of the process, improved focusing at higher ion currents, and more stable running conditions are discussed. The performance of the separator is illustrated by some actual investigations. The applications include mass assignments, β- and γ-ray spectrometry, half-life determinations in the region below 1 msec, measurements of relative yields of spallation and high-energy fission products, and "hot atom chemistry". A.

539.18

6363. THE POSSIBILITIES OF MULTIPLE MONOCHROMATIZATION APPLIED TO THE ELECTROMAGNETIC SEPARATION OF ISOTOPES. C.Cassignol.
C.R. Acad. Sci. (Paris), Vol. 246, No. 9, 1413-16 (March 3, 1958).
In French.

A theory of isotopic contamination, based principally on results of experiments on double electrostatic monochromatization, is described. The application of this theory to a number of systems suggests that values of isotopic enrichment might be obtained which surpass, by several orders of magnitude, the best values obtained to date. H.C.Cole

539.18

6364. THE SEPARATION OF HYDROGEN AND DEUTERIUM BY THE REACTION OF IRON WITH STEAM. H.A.Smith and J.C.Posey.
J. Amer. Chem. Soc., Vol. 79, No. 6, 1310-13 (March 20, 1957).

The separation of hydrogen and deuterium during the reaction of steam and iron was measured over the range of 118 to 340°C. Separation factors from 1.4 to 3.2 were observed. The data were found to be correlated by the equation $\log \alpha = 273.1/T - 0.2039$, where α is the isotope separation factor and T is the absolute temperature. Isotope separation factors obtained with cadmium agreed within experimental error with those obtained with iron. The separation of hydrogen and deuterium occurring during the reduction of magnetic iron oxide was measured and found to approach the equilibrium value. This is believed to have been caused by isotope exchange catalysed by the freshly reduced iron. A.

539.18

6365. PRELIMINARY REPORT ON AN ELECTROMAGNETIC ISOTOPE SEPARATOR. J.Okano.
J. Phys. Soc. Japan, Vol. 12, No. 4, 390-400 (April, 1957).

The focusing characteristics of the Smythe-type magnetic lens were investigated, and a small mass-separator based on this system was constructed. The apparatus has an ion radius of 50 cm in the magnet, and has two ion sources which can be operated independently and simultaneously. The characteristics of the source (Finkelstein type) were investigated in conjunction with the electrostatic lens system. The maximum ion current on the collector was about 400 μA and 1 mA for neon and magnesium, respectively. A.

539.18

6366. THE SEPARATION OF THE ISOTOPES OF CARBON BY THERMAL DIFFUSION OF CARBON MONOXIDE.
N.N.Tunitskiĭ, G.G.Devyatykh, P.C.Pemrov and B.Z.Torlin.
Zh. tekh. Fiz., Vol. 28, No. 4, 881-4 (1958). In Russian.

The properties of carbon monoxide as a working gas are investigated in two glass columns (14.5 and 9.0 mm diameter, 1 and 2 metres long, 0.6 and 0.4 mm platinum wires). The results are found to be in agreement with the theory of Jones, Furry and Onsager. The cascade parameters are estimated for a plant designed to produce 1 g per day of carbon containing 20% C^{13} using carbon monoxide in hot-wire columns, and are compared with the cascade parameters for a similar plant using methane in concentric tube columns. H.C.Cole

539.18 : 535.33.03

PURITY OF Hg^{198} PRODUCED BY NEUTRON IRRADIATION OF Au^{197}. See Abstr. 5758

539.18 : 536.423.1

VAPOUR PRESSURE RATIOS OF N^{14} N^{14}, N^{14}, N^{15} AND N^{15} N^{15}. See Abstr. 5840

539.18 : 536.48

THE PHASE SEPARATION OF He^3-He^4 MIXTURES. See Abstr. 5844

539.18 : 537.534.3

THE ISOTOPE SEPARATOR AT THE NOBEL INSTITUTE OF PHYSICS. See Abstr. 5987

539.18 : 539.12

6367. SMALL ANGLE SCATTERING OF 1.33 MeV AND 1.17 MeV GAMMA RAYS. A.Storruste and P.O.Tjøm.
Nuclear Phys., Vol. 6, No. 2, 151-6 (March [3], 1958).

The differential scattering cross-section for gamma rays of energy of 1.33 MeV and 1.17 MeV scattered by lead and copper at angles varying from 1° to 8° was measured. The result is in fair agreement with the elastic scattering cross-section calculated by the form factor method and the Hartree electron distribution. A

539.18

6368. NOTE ON THE He—He INTERACTION POTENTIAL AND ITS DETERMINATION FROM AMDUR'S SCATTERING MEASUREMENTS. Ta-You Wu.
J. chem. Phys., Vol. 28, No. 5, 986-7 (May, 1958).

Theoretical He—He interaction potential energy curves are consistently higher than Amdur's experimental curves. In previous theoretical calculations, use of molecular orbitals in the He—He system which do not go over into the correct Be wave-function, as th interatomic distance tends to zero, may explain the high results. The use of classical mechanics in the derivation of Amdur's results is criticized in detail. M.J.Kearsley

539.18

6369. COMMENTS ON "NOTE ON THE He—He INTERACTION POTENTIAL AND ITS DETERMINATION FROM AMDUR'S SCATTERING MEASUREMENTS". I.Amdur.
J. chem. Phys., Vol. 28, No. 5, 987-8 (May, 1958).

The use of classical mechanics in Amdur's determination of the He—He interaction potential criticized in Wu's note (preceding abstract) is defended in detail. M.J.Kearsley

539.18

6370. INTERACTIONS OF H^- IONS AND H ATOMS WITH Ne, A, AND H_2. E.A.Mason and J.T.Vanderslice.
J. chem. Phys., Vol. 28, No. 6, 1070-4 (June, 1958).

Previous work on the systems H^-—He and H—He serves as a model for the calculation of the interactions of H^- ions and H atoms with Ne, A, and H_2 from an analysis of beam scattering measurements. It is shown that a mutually consistent interpretation can be developed on the assumption that the forces are repulsive in the region of interest. The H^- ion elastic scattering cross-sections are used to calculate the interactions of H^- with Ne, A, and H_2, and the electron detachment cross-sections are used to locate the points at which these potential energy curves cross the corresponding curves for H atoms. The crossing points are shown to be consistent with potential energy curves for the interactions of H atoms with Ne, A, and H_2 obtained directly or indirectly from independent scattering measurements involving beams of H atoms. The crossing points are used to extend these potential energy curves over a wider range of validity than previously available. Such a mutually consistent picture does not seem to emerge when attractive forces are assumed for the H^- interactions. A.

MOLECULES

539.19

6371. EVALUATION OF MOLECULAR INTEGRALS BY DIGITAL COMPUTER. C.C.J.Roothaan.
J. chem. Phys., Vol. 28, No. 5, 982-3 (May, 1958).

Outline of programmes for the 1103 computer completed and envisaged by the Chicago group for fully automatic LCAO-SCF calculations on diatomic molecules with 1s, 2s and 2p Slater orbitals. J.Hawgood

539.19

6372. COMMENTS ON "THEORY OF ISOTROPIC HYPERFINE INTERACTIONS IN π-ELECTRON RADICALS".
H.M.McConnell and R.E.Robertson.
J. chem. Phys., Vol. 28, No. 5, 991-2 (May, 1958).
See Abstr. 2016 (1958).

539.19

373. THERMODYNAMIC PROPERTIES OF INTERNAL OTATORS WITH SMALL MOMENTS OF INERTIA. J.O.Halford.
phys. Chem., Vol. 61, No. 12, 1581-4 (Dec., 1957).

A method of evaluating the partition function for internal rotation hich applies integration only to systematic parts of the external ne-dimensional rotator series is described. The method is used in erifying the equations and tabulated thermodynamic properties of i and Pitzer (Abstr. 7583/1956) and in determining the spread of rtition functions which must be represented by a single entry in ie general free energy table. A.

539.19

374. ON THE "REDUNDANT COORDINATE" PROBLEM IN THE OTATIONAL—VIBRATIONAL SPECTRA OF POLYATOMIC OLECULES. R.Gold, J.M.Dowling and A.G.Meister.
molecular Spectrosc., Vol. 2, No. 1, 9-26 (Feb., 1958).

A consistent method is described for treating redundant ordinates in the Wilson treatment of the rotational—vibrational oblem of polyatomic molecules. This method furnishes a unique t of potential constants for molecules having redundant internal ordinates. Techniques are developed which permit the calculation the rotational distortion constants by use of the internal coordinates. method is given for obtaining the partial derivatives of the moment inertia tensor with respect to the internal coordinates which is plicable even when redundant coordinates are present. The results r a ZX_3Y molecule are tabulated in matrix form. A.

539.19

375. VIBRATIONAL L-TYPE DOUBLING AND L-TYPE ESONANCE IN LINEAR POLYATOMIC MOLECULES.
.Amat and H.H.Nielsen.
. molecular Spectrosc., Vol. 2, No. 2, 152-62 (April, 1958).

The effect on the vibration—rotation energy of a linear olecule of certain terms in the potential energy function which re nondiagonal in the quantum numbers of vibrational angular omentum, l_t and $l_{t'}$, but diagonal in the quantum number $l = l_t + l_{t'}$ re studied. These terms, which are usually not included in the otential energy functions of linear molecules, depend not only upon ie displacement coordinates, but also upon the difference between ie polar angles χ_t and $\chi_{t'}$ which the polar displacement vectors t and $r_{t'}$ make with an axis normal to the internuclear axis. The ffect is to introduce terms in the anharmonic portion of the ibrational energy of the form $x_{tt'} l_t l_{t'}$, but more generally it nfluences also the effective vibrational and rotational constants f the molecule. The latter effect can only be taken into account y solving a secular determinant. By analogy to the rotational -type doubling this effect has been referred to as vibrational l-type oubling. A.

539.19

376. ROTATIONAL DISTORTION IN LINEAR MOLECULES RISING FROM L-TYPE RESONANCE.
.Amat and H.H.Nielsen.
. molecular Spectrosc., Vol. 2, No. 2, 163-72 (April, 1958).

It is pointed out that in linear molecules where rotational istortion of the energy levels arises out of l-type resonance lone that the expansion of the energies in powers of $J(J+1)$ is equently invalid except for small values of J. An application of ie refined theory is made to the band $2\nu_5$ in the spectrum of DCN nd the band $\nu_4 + \nu_5$ in the spectrum of C_2H_2. It is further pointed ut that in molecules where Fermi resonance and l-type resonance ccur simultaneously, the expansion of the energies in powers f $J(J+1)$ is valid for strong Fermi coupling but that for weak ermi coupling, care must be exercised since here the expansion ethod may break down. Finally it is indicated that rotational istortion of the variety discussed does not occur in π vibration tates. A.

539.19

377. A COMPLETE RULE FOR THE VIBRATIONAL FRE-UENCIES OF CERTAIN ISOTOPIC MOLECULES.
.Brodersen and A.Langseth.
. Danske Vidensk. Selsk. mat.-fys. Skr., Vol. 1, Paper 5, 21 pp. 1958).

The existence of an isotopic rule in addition to the product rule nd the sum rule is demonstrated. This rule allows the calculation f all the frequencies of certain partly isotopically substituted com-ounds exclusively from the frequencies of the corresponding full-ymmetry compounds. An equation between the secular determinants f the classes in question is a convenient expression for the rule. A etailed description is given of the procedure for setting up this equation. The conditions for the validity of the rule are discussed, the result being roughly that the full-symmetry compounds should be either linear and symmetrical or plane, but of higher symmetry than C_s. Some of the rules are strictly valid within the harmonic approximation (and in fact better); others are based on the further approximation of separating low and high frequencies. In a special chapter the rules are formulated for molecules of some of the more important point groups. The rule is used to calculate the frequencies of all the partly deuterated species of acetylene and ethylene. The agreement with observed values is at least as good as for calculations based on a harmonic potential function. A.

539.19

6378. ENERGY LEVELS OF AN ASYMMETRIC ROTOR.
J.G.Baker.
Phys. Rev., Vol. 110, No. 1, 282 (April 1, 1958).

There is a need in microwave spectroscopy for extension of tables of rotational energy of a rigid rotor to high values of J. This is met by modification of the method of Golden (Abstr. 1288/1948) using a "step-up" process to obtain energy levels of high J from those already listed for low J. R.C.Seymour

539.19

6379. HYPERFINE STRUCTURE OF THE ROTATIONAL TRANSITION $J = 3 \rightarrow 4$ OF CH_3I^{127}. B.D.Osipov.
Optika i Spektrosk., Vol. 3, No. 1, 94-5 (1957). In Russian.

A table comparing calculated and experimental results is given for various transitions with different K values. Molecular constants are given as: $B = 7501.31$ Mc/s, $D_J = 7.95$ kc/s, $D_{JK} = 99.4$ kc/s, $eQq = -1934$ Mc/s. L.Bovey

539.19

6380. ELECTRONIC STRUCTURE OF WATER IN ITS LINEAR CONFIGURATION. L.Burnelle.
Bull. Acad. Roy. Belgique Cl. Sci., Vol. 43, No. 9, 647-52 (1957). In French.

Ellison and Shull's wave-function for the linear configuration of water was improved by the introduction of a resonance effect between structures involving bent bonds. The value found for the transverse bond moment fits in fairly well with those obtained for the angular configurations. A.

539.19

6381. ELECTRONIC STRUCTURE OF SIMPLE HOMONUCLEAR DIATOMIC MOLECULES. I. OXYGEN MOLECULE.
M.Kotani, Y.Mizuno, K.Kayama and E.Ishiguro.
J. Phys. Soc. Japan, Vol. 12, No. 6, 707-36 (June, 1957).

The wave-functions of the ground state and several lower excited states of O_2 and O_2^+ are calculated non-empirically at $R = 2.3$ A by the LCAO MO method, where all sixteen electrons are taken into considered and Slater type 1s, 2s, and 2p atomic orbitals are used. For the ground state of O_2, various approximate treatments are investigated. For $^1\Delta_g$, $^1\Sigma_g^+$, $^1\Sigma_u^-$, $^3\Sigma_u^+$, and $^3\Sigma_u^-$ states, improved calculations are performed by mixing several configurations. By using the wave-functions thus obtained, dissociation energy D_e, excitation energies ΔE, molecular quadrupole moment Q, magnetic hyperfine structure parameters $\langle\psi^2(0)\rangle$ and $\langle P_2/r^3\rangle$, oscillator strengths f, diamagnetic second-order Zeeman term $\chi_{dia.}$, and polarizabilities $\alpha_{\parallel}$ and $\alpha_{\perp}$ are calculated and compared with the observed values. The results are found to be improved appreciably by mixing a small number of configurations. Finally, several of the wave-functions of the O_2 ground state are analysed by the population analysis method developed by Mulliken. A.

539.19

6382. ELECTRONIC STRUCTURE OF SIMPLE HOMONUCLEAR DIATOMIC MOLECULES. II. LITHIUM MOLECULE.
E.Ishiguro, K.Kayama, M.Kotani and Y.Mizuno.
J. Phys. Soc. Japan, Vol. 12, No. 12, 1355-85 (Dec., 1957).

Based on the LCAO MO CI method, the wave-functions of Li_2 in the ground state $^1\Sigma_g^+$ and three lower excited states $^3\Sigma_u^+$, $^1\Sigma_u^+$, and $^1\Pi_u$ are calculated non-empirically. Calculation is performed at internuclear distances of 4.5, 5.0 and 5.5 A by use of 1s, 2s, and 2p atomic orbitals of the Slater type. For the ground state, various approximations are investigated. Among other results it is noted that the HL method gives a lower total energy than MO method, and that in CI wave-functions a configuration corresponding to the π-bond appears with an unexpectedly large coefficient. By using these wave-functions depth of adiabatic potentials, dissociation energy, and vertical excitation energies are calculated and compared with the observed values. Further, molecular quadrupole moment, gradient of

the electric field at each nucleus, and oscillator strengths are calculated. It is found that, in general, CI improves appreciably the values of these quantities calculated by the single configuration. Some of these wave-functions are analysed by the population analysis method developed by Mulliken. Finally, it is examined to what extent the virial theorem is satisfied by the present wave-functions and the reason for the disagreement is discussed. A.

539.19

6383. ON THE ELECTRONIC STRUCTURE OF THE BH MOLECULE. K.Ohno.
J. Phys. Soc. Japan, Vol. 12, No. 8, 938-50 (Aug., 1957).

A nonempirical calculation of the electronic structure of the BH molecule based on a simple Heitler—London method is attempted. It is found that the results are in rather poor agreement with experiment and configuration interaction (CI) must be invoked. In the CI calculation account is taken of all the configurations in which two electrons are retained in the 1s orbital of the boron atom. Thus 13 $^1\Sigma^+$, 12 $^3\Pi$, 11 $^1\Pi$, 9 $^3\Sigma^-$, 6 $^3\Sigma^+$, 6 $^1\Delta$, 3 $^3\Sigma^-$, 3 $^3\Delta$, 3 $^1\Sigma^-$ and 1 $^5\Pi$ configurations are obtained. In constructing the energy matrices, the orthogonalized atomic orbitals are used and the eigenvalue and eigenfunction of the lowest energy state of each symmetry is got by solving the secular equation. The results show marked improvement on those of the single configuration calculation. A new non-empirical modification, in which intra-atomic energies are evaluated with atomic orbitals whose orbital exponents are adjusted according to an ionicity of the atom, is tried and leads to satisfactory results. A.

539.19

6384. PROTON RELAXATION IN WATER.
S.Meiboom, Z.Luz and D.Gill.
J. chem. Phys., Vol. 27, No. 6, 1411-12 (Dec., 1957).

Measurements were made of the transverse and longitudinal relaxation times of protons in water as a function of pH value. A spin-echo technique was used and the pH varied by the addition of HCl and NaOH. T_1 remained approximately constant but T_2 ($< T_1$) varies appreciably. It is suggested that in the central pH range part of the relaxation is due to the breaking and reforming of hydrogen bonds between the water molecules, but some other mechanism must be operative at the extremes of the pH range. J.M.Baker

539.19

6385. QUADRUPOLE COUPLING OF SOLID CYANOGEN CHLORIDE. P.A.Casabella and P.J.Bray.
J. chem. Phys., Vol. 28, No. 6, 1182-7 (June, 1958).

The nuclear quadrupole resonances of N^{14} and Cl^{35} were observed in solid ClCN. In the course of study of the N^{14} resonances a detailed study was made of the shape of the negative wings which occur when Zeeman modulation and phase sensitive detection are used. The shape of these wings can reveal whether two resonances are due to two nonequivalent positions of the N^{14} nuclei, or one position with a nonzero asymmetry parameter. A theoretical expression is derived for the shape of the wings which agrees with the experimental results. The coupling constants of the Cl^{35} and N^{14} nuclei are interpreted in terms of a set of hybrid structures. A.

539.19

6386. NUCLEAR QUADRUPOLE RESONANCE OF NEUTRON-IRRADIATED SODIUM CHLORATE. J.Depireux and J.Duchesne.
Nature (London), Vol. 181, 759 (March 15, 1958).

A decrease in the intensity of the nuclear quadrupole resonance of Cl^{35} in sodium chlorate is observed when the sample is irradiated with fast neutrons. The line intensity is found to decrease exponentially with the dose given, but there is no shift of the line frequency nor increase in the line width. J.M.Baker

539.19

6387. ELECTRON-COUPLED INTERACTION BETWEEN NUCLEAR SPINS IN HD MOLECULE. E.Ishiguro.
Phys. Rev., Vol. 111, No. 1, 203-8 (July 1, 1958).

Electron-coupled interaction between two nuclear spins I_A and I_B is of the form $h\delta_{AB}I_A \cdot I_B$. Formulae for calculating δ_{AB} are derived by using the variational method. By using these formulae, δ_{AB} is calculated for the HD molecule at internuclear distances of 1.3, 1.4, and 1.5 atomic units. The total wave-function was chosen as a linear combination of seven independent functions of $^1\Sigma_g^+$ symmetry, representing the unperturbed state, and several additional functions, to represent the perturbation. The average value of δ_{AB} over the zero-point vibration, $\langle\delta_{AB}\rangle_{00}$, is found to be 37.138 c/s. Further, the refinement of a part of the calculations is undertaken by use of the 11-term James and Coolidge wave-function. The final result is $\langle\delta_{AB}\rangle_{00} = 35.217$ c/s. The agreement with the observed value of 42.7 ± 0.7 c/s is satisfactory, considering that only a few terms are used for the additional perturbative wave-function and th the result is a sum of terms which cancel each other appreciably. Contributions from each perturbing Hamiltonian and also from a se of wave-functions with different symmetry character were obtained separately. The various results are presented and discussed.

A

539.19

6388. HYPERCONJUGATION IN THE SEMIEMPIRICAL ASMO METHOD. T. Morita.
J. chem. Phys., Vol. 27, No. 6, 1442 (Dec., 1957).

Pariser—Parr type calculations on toluene and ethylene agree well with experimental values of hyperconjugation energy.

J.Hawgoo

539.19

6389. DIPOLE MOMENTS OF DIATOMIC MOLECULES.
B.F.Gray and H.O.Pritchard.
J. molecular Spectrosc., Vol. 2, No. 2, 137-43 (April, 1958).

The effect of the presence of an electric field on the adiabatic approximation for a diatomic molecule is considered, and it is concluded that, to within experimental accuracy, the dipole moment can be calculated by averaging the "static" dipole moment over the molecular vibration. The variation of molecular dipole with vibrational excitation is investigated numerically, and, in an appendix, a possible inversion in relative vibrational absorption intensities is predicted.

A

539.19

6390. LENGTH OF THE SINGLE BOND BETWEEN TRIGONALLY HYBRIDIZED CARBON ATOMS. D.Cook.
J. chem. Phys., Vol. 28, No. 5, 1001-2 (May, 1958).

The relationship between the length of the single bond and the angle between the planar groups joined by the single bond is graphically represented for a series of diphenyl derivatives. A distinct trend to shorter bond lengths is observed as the angle decreases.

G.I.W.Llewely

539.19

6391. POTENTIAL BARRIER AND MOLECULAR STRUCTURE OF METHYL MERCAPTAN FROM ITS MICROWAVE SPECTRA.
T.Kojima and T.Nishikawa.
J. Phys. Soc. Japan, Vol. 12, No. 6, 680-6 (June, 1957).

The microwave spectrum of normal methyl mercaptan was studied in the frequency range from 14 to 29 kMc/s. The potential barrier height hindering internal rotation is determined as 444 ± 10 cm^{-1}, from the analysis of the lines corresponding to the transitions involving both over-all and internal rotations. The fine structure of $J = 1 \leftarrow 0$, $K = 0 \leftarrow 0$ lines of the various isotopic species are also analysed. The molecular structure of methyl mercaptan is calculated to be $d_{SH} = 1.336 \pm 0.01$ A, $d_{CS} = 1.819 \pm 0.005$ A, $d_{CH} = 1.091 \pm 0.01$ A, $\angle CSH = 96°30' \pm 1°$, $\angle HCH = 109°45' \pm 30'$ and the angle between the CS bond and the methyl axis, $\theta = 2°0' \pm 30'$. A

539.1

6392. POLARIZATION OF A MOLECULAR BEAM BY AN ALTERNATING FIELD WITH CHANGING AMPLITUDE AND PHASE.
G.P.Lyubimov and R.V.Khoklov.
Zh. éksper. teor. Fiz., Vol. 33, No. 6(12), 1396-402 (1957).
In Russian.

Equations are derived which describe the behaviour of a molecular beam under the action of an alternating field with changing amplitude and frequency. The equations are solved for various cases. An exact solution is derived for the case when the frequency of the applied field with a changing amplitude is the same as that of the molecular transition. Approximate solutions are obtained for field amplitudes and frequencies which change slowly or rapidly during the time of flight through the cavity.

A

SOLID-STATE PHYSICS

538.

6393. MADELUNG CONSTANTS OF SIMPLE CRYSTALS EXPRESSED IN TERMS OF BORN'S BASIC POTENTIALS OF 15 [SIGNIFICANT] FIGURES. Y.Sakamoto.
J. chem. Phys., Vol. 28, No. 1, 164-5 (Jan., 1958).

539.2 : 536.42

6394. SULFUR: A POSSIBLE METALLIC FORM.
H.G.David and S.D.Hamann.
J. chem. Phys., Vol. 28, No. 5, 1006 (May, 1958).

Sulphur was compressed to 230 000 atm by a shock, and in this state it discharged an RC circuit, giving a specific resistance of 0.03 ohm cm. P.Gray

539.2

6395. THE INTERNAL FIELD IN DIPOLE LATTICES.
B.R.A.Nijboer and F.W.de Wette.
Physica, Vol. 24, No. 6, 422-31 (1958).

The internal field for Bravais lattices of equal parallel dipoles having monoclinic and higher symmetry is evaluated. The electric field at a lattice point due to all the other dipoles in the lattice is given by a conditionally convergent sum. It is shown that, when considering a slab of dielectric material in a parallel plate condenser, this "dipole sum" should be summed "plane-wise" in order to obtain the correct contribution to the internal field. Rapidly converging expressions for this contribution are derived. For a simple cubic lattice the resulting expression for the internal field reduces to that of Lorentz. A.

539.2

6396. ON THE CALCULATION OF LATTICE VIBRATIONS IN KCl.
E.Tenerz.
Ark. Fys., Vol. 12, Paper 9, 277-85 (1957).

The aim of this investigation is to estimate the distribution function of lattice vibrations at 0°K in KCl. Earlier Iona (1941) determined it from the elastic constants and the residual ray frequency measured at room-temperature using the classical Born model. This computation is recalculated with new empirical constants measured at 293°K. Since the residual ray frequency is not known at 0°K, the Born model according to Iona cannot be used in the calculation of the distribution function at 0°K. Therefore a modified model was used where the classical ionic charge is replaced in the Coulomb interaction by an effective charge, which Lundqvist (1955) studied in a quantum-mechanical investigation. The specific heat c_V and the Debye temperature θ_D are computed from this distribution function. The agreement between the calculated values of θ_D and the experimental values at low temperatures is not so good as that obtained by Iona. In a preliminary calculation the agreement seems to be better if the polarization, here excluded, is also taken into account.

A.

539.2

6397. ON THE COUPLING OF VIBRATIONS OF COMPLEX IONS OR MOLECULES IN THE CRYSTAL LATTICE. H.Poulet.
C.R. Acad. Sci. (Paris), Vol. 246, 738-40 (Feb. 3, 1958). In French.

It is shown that expressions for the polarizability derivative previously given (e.g., Couture and Mathieu, Abstr. 546/1949) must be modified. G.F.Lothian

539.2 : 539.219

6398. A METHOD FOR DETERMINING THE AMPLITUDE OF THERMAL VIBRATIONS OF DIFFERENT KINDS OF ATOMS IN SOLID SOLUTION. A.P.Zvyagina and V.I.Iveronova.
Kristallografiya, Vol. 2, No. 5, 613-17 (1957). In Russian.

The method, which involves comparison between observed and theoretical X-ray diffracted intensities, is applied to Cu_3Au and Fe—W (1.9% W) alloys. The mean square displacements in angstroms are: Cu, 0.18; Au, 0.12; Fe, 0.11; W, 0.05.

R.F.S.Hearmon

539.2 : 548.74

6399. NORMAL MODES OF ALUMINUM BY NEUTRON SPECTROMETRY. B.N.Brockhouse and A.T.Stewart.
Rev. mod. Phys., Vol. 30, No. 1, 236-49 (Jan., 1958).

The relations between the frequency and propagation vector of the normal modes of vibration of Al were determined by neutron scattering measurements for the (110) and (100) planes of an Al single crystal. Both the crystal spectrometer and "cold-neutron" methods were used. The results agree fairly well with the dispersion relations obtained from X-ray intensity measurements by Walker, and with his nine-constant calculated dispersion curves for other directions. J.Thewlis

539.2 : 548.74

6400. VIBRATION SPECTRA OF VANADIUM AND A Mn—Co ALLOY BY NEUTRON SPECTROMETRY.
A.T.Stewart and B.N.Brockhouse.
Rev. mod. Phys., Vol. 30, No. 1, 250-5 (Jan., 1958).

The frequency distributions of the normal modes of vibration were determined by measurements of incoherent neutron scattering using "cold" neutrons ($\lambda > 3.96$ A). V was chosen because its coherent scattering cross-section is very low. The Mn—Co alloy was so chosen that the positive and negative scattering lengths of Mn and Co cancelled out: it was examined in the disordered state. The results for V show two frequency peaks somewhat closer together than had been expected. The vibration spectrum agrees quite well at low frequencies with that determined by low-temperature specific heat measurements and the calculated specific heat agrees well at various temperatures with that calculated for a Debye model with a characteristic temperature of 338°K. The Mn—Co alloy gave discrepant results.

J.Thewlis

539.2 : 548.74 : 538.114

CRITICAL MAGNETIC SCATTERING OF NEUTRONS IN FERROMAGNETS. See Abstr. 6028-30

539.2 : 539.12

SCATTERING OF SLOW NEUTRONS BY KCl. See Abstr. 6147

539.2 : 539.12

TWO-PHONON PROCESSES IN NEUTRON DIFFRACTION. See Abstr. 6148

539.2

6401. APPLICATION OF GROUP THEORY TO CALCULATION OF SPIN—ORBIT COUPLING IN CRYSTALS. F.Englert.
Bull. Acad. Roy. Belgique Cl. Sci., Vol. 43, No. 4, 273-83 (1957). In French.

The spin—orbit coupling perturbation in crystals is evaluated along the symmetry axis of a Brillouin zone by a systematic use of group theory. This method is applied to compute the valence band of Ge in the (100) direction of a Brillouin zone. A.

539.2 : 535.39 : 536.631

6402. OPTICAL CONSTANTS, HEAT CAPACITY AND THE FERMI SURFACE. M.H.Cohen.
Phil. Mag. (Eighth Ser.), Vol. 3, 762-75 (July, 1958).

Thermal and optical effective masses are defined and expressions for them obtained for metals with arbitrary Fermi surfaces. The ratio of these two effective masses is shown to depend on the shape of the Fermi surface. It follows from experimental values of the optical constants and the electronic heat capacity that the Fermi surface is not spherical in Cu, Ag and Au and that it contacts the surface of the first Brillouin zone to an appreciable degree in Cu and Ag. Similar evidence indicates a non-spherical Fermi surface in Li, Na and K. A simplification of the thoery of the optical constants of metals is given which fits the experimental data for Na, K, Rb and Cs satisfactorily. Values of the plasma frequencies and widths of the plasma resonances of the alkali metals are calculated.

A.

539.2

6403. THE SURFACE ENERGIES OF SOLID OXIDES AND CARBIDES. D.T.Livey and P.Murray.
Atomic Energy Res. Establ. (Harwell), Rep. M/R1846, 21 pp. (1956).

The surface energies of the alkali halides are considered in relation to lattice energy, molar volume, and heat of formation. The conclusions derived are applied to a consideration of the surface energies of oxides which range in value from 250 ergs/cm^2 for PbO to $>$ 1420 ergs/cm^2 for BeO. Agreement is generally good between the predicted value from those relations and the available data. Exceptions arise in those oxides which either contain heavy metal ions such as Cd^{++} and Pb^{++} or cations of high polarizing power such as B^{3+} and Si^{4+} leading to polarization effects and surface screening of the cations and the production of low energy surfaces. The surface energies of the refractory monocarbides, as determined from wetting experiments, are shown to vary linearly with their heats of formation. A.

539.2

6404. GROUND-STATE ENERGY AND STOPPING POWER OF AN ELECTRON GAS. P.Nozières and D.Pines.
Phys. Rev., Vol. 109, No. 3, 1009-10 (Feb. 1, 1958).

Shows the equivalence of the existing treatments of the free-electron gas and that all the results may be inferred from a knowledge of the complex dielectric constant as a function of frequency and wave-vector. D.M.Edwards

539.2

6405. CYCLOTRON RESONANCE IN FILMS. É.A.Kaner.
Dokl. Akad. Nauk SSSR, Vol. 119, No. 3, 471-4 (1958). In Russian.

Earlier work on cyclotron resonance in metals is extended to the case of a monocrystalline metallic film of thickness comparable with those encountered in the anomalous skin effect.

S.F.Edwards

539.2

6406. ON THE THEORY OF CYCLOTRON RESONANCE IN METALS. É.A.Kaner and M.Ya.Azbel'.
Zh. éksper. teor. Fiz., Vol. 33, No. 6(12), 1461-71 (1957). In Russian.

The surface impedance of a metal in a high-frequency electromagnetic and a constant magnetic field parallel to the surface of the metal is computed for an arbitrary dispersion law and arbitrary collision integral. The dependence of the surface impedance on the magnetic field and temperature throughout the whole region of the magnetic fields is investigated. The possibility of deriving the shape of the boundary Fermi surface, the electron velocity on it and the transition probability for colliding electrons are also discussed. Predictions of the theory are compared with experiments on cyclotron resonance in metals. A.

539.2

6407. CONCERNING THE THEORY OF CYCLOTRON RESONANCE. É.A.Kaner.
Zh. éksper. teor. Fiz., Vol. 33, No. 6(12), 1472-6 (1957). In Russian.

The possibility of cyclotron resonance in a metal situated in an inclined magnetic field is investigated. The surface impedance of a metal in a parallel magnetic field is calculated for an arbitrary law of reflection of the electrons from the metal surface. A.

539.2 : 537.311.33

SCREENING OF A COULOMB FIELD BY FREE CHARGES IN METALS. See Abstr. 5878

539.2 : 537.312.5

ATOM STRUCTURE STUDIES USING PHOTO AND AUGER ELECTRONS. See Abstr. 5910

539.2 : 538.221

ELECTRONIC STRUCTURE OF $CuCl_2.2H_2O$. See Abstr. 6049

539.2 : 539.12

POSITRON ANNIHILATION IN METALS. See Abstr. 6130

539.2

6408. THE ENERGY OF AN EXCITON OF AN IONIC CRYSTAL. V.A.Moskalenko.
Dokl. Akad. Nauk SSSR, Vol. 119, No. 4, 678-81 (1958). In Russian.

A variational calculation is given for the energy using a trial action in the Feynman integral. S.F.Edwards

539.2

6409. PECULIARITIES IN THE MOTION OF FAST CURRENT CARRIERS IN POLAR CRYSTALS. Yu.I.Gorkun and K.B.Tolpygo.
Dokl. Akad. Nauk SSSR, Vol. 120, No. 3, 491-4 (1958). In Russian.

Equations describing the motion of a fast polaron in a crystal lattice are set up and solved approximately. A.L.Mackay

539.2 : 537.311.31

SPIN-DISORDER EFFECTS IN THE ELECTRICAL RESISTIVITIES OF METALS AND ALLOYS. See Abstr. 5868

539.2

6410. CONVERGENCE OF THE METHOD OF MOMENTS. F.R.Halpern.
Phys. Rev., Vol. 111, No. 1, 1-2 (July 1, 1958).

A proof is given that the nth approximation of the method of moments is convergent when applied to the polaron problem. A.

539.2 : 539.371

6411. INFLUENCE OF THE DEFORMATION CONDITIONS ON THE MECHANISM OF KINK BAND FORMATION. E.V.Kolontsova and I.V.Telegina.
Kristallografiya, Vol. 2, No. 5, 658-62 (1957). In Russian.

An X-ray method is used to investigate the effect of deformation velocity and initial orientation of the specimen on the structure of kink bands in extended tin single crystals. Under some conditions, twinning is observed. R.F.S.Hearmon

539.2 : 539.374

THE LATTICE EXPANSION OF PURE Cu WHEN PLASTICALLY DEFORMED. See Abstr. 5500

539.2

6412. THE INTERACTION BETWEEN EQUILIBRIUM DEFECTS IN THE ALKALI HALIDES: THE "FIRST EXCITED STATE" BINDING ENERGIES OF THE IMPURITY COMPLEX AND OF THE VACANCY PAIR. M.P.Tosi and G.Airoldi.
Nuovo Cimento, Vol. 8, No. 4, 584-9 (May 16, 1958).

The experimentally observed presence in NaCl and KCl crystals of comparable concentrations of complexes between divalent impurity cations and positive-ion vacancies in the ground and first excited states, is shown to be in agreement with the results yielded by the Born—Mayer theory of ionic crystals. Theoretical estimates for the binding energy of the first excited state of the Sr^{2+} impurity complex and of the vacancy pair in NaCl and KCl crystals are presented and discussed. A.

539.2 : 537.311.33

6413. DISTRIBUTION COEFFICIENTS FOR SOLUTE ELEMENTS IN SINGLE CRYSTAL INDIUM ANTIMONIDE. J.B.Mullin.
J. Electronics and Control, Vol. 4, No. 4, 358-9 (April, 1958).

Direct measurements using radioactive tracers have yielded values for fourteen different impurities in InSb. C.A.Hogarth

539.2 : 535.343

LATTICE IMPERFECTIONS IN α-QUARTZ. See Abstr. 5782

539.2

6414. EFFECT OF PLASTIC DEFORMATION ON THE γ-RAY COLORATION OF NaCl CRYSTALS. A.S.Nowick.
Phys. Rev., Vol. 111, No. 1, 16-25 (July 1, 1958).

Measurements are made at room temperature of the growth of the F-band in NaCl crystals, under gamma irradiation in a Co^{60} source of constant intensity. Crystals of different origins, heat treatments, and states of deformation, are examined. While deformation has only a relatively small effect on the colorability in the early stage of F-band growth, the effect on the later stage is quite striking. The annealed crystals appear to saturate sharply at a value close of 10^{17} F-centres/cm^3, except for a small linear increase with time, while the deformed crystals continue to show a high growth rate in the later stage of irradiation. Upon optical bleaching, the deformed crystals show R-bands, while undeformed crystals irradiated for the same time show no absorption maxima in the visible range. These and other observations confirm the concept advanced earlier that the first stage is due to vacancies and vacancy clusters present in the crystal prior to irradiation (which are determined by the impurity content of the crystal) while the second stage involves the generation of new vacancies at dislocations. A.

539.2

6415. EFFECT OF FRACTIONAL X-IRRADIATION OF NaCl CRYSTALS ON F-CENTER DENSITY. W.E.Bron and A.S.Nowick.
Phys. Rev., Vol. 111, No. 1, 26-7 (July 1, 1958).

An attempt is made to verify an effect reported by Lin (Abstr. 6251/1956) whereby the F-centre density in an alkali halide crystal irradiated over only part of its cross-section is proportional to the fraction of the crystal exposed to the X-ray beam. These experiments fail to verify Lin's results, and in fact show that, within experimental error, the F-centre density produced in a crystal exposed to a given intensity of X-rays for a given time is independent of the fraction of the crystal irradiated. A.

539.2

6416. OPTICAL ABSORPTION MEASUREMENTS ON SILVER ACTIVATED ALKALI HALIDES.
W.Maenhout-van der Vorst and W.Dekeyser.
Physica, Vol. 23, No. 9, 903-4 (Sept., 1957).

A discussion of the models for various colour centres is given. Corrections are suggested on the basis of new results to the models for the A, B, C and D bands of NaCl—Ag and KCl—Ag proposed by Etzel and Schulman (Abstr. 11550/1954) and a new model added for their E band. G.F.J.Garlick

539.21

6417. HARDENING OF COPPER SINGLE CRYSTALS IRRADIATED AT −195° C. M.J.Makin.
Acta metallurgica, Vol. 6, No. 4, 305-6 (April, 1958).

Samples were irradiated, stored and tested at −195° C. The critical shear stress was substantially increased by irradiation. After annealing at 80° C the critical shear stress is reduced by 7% and a "bump", which was observed on the stress—strain curve of unannealed samples, disappeared. About 50% of the reduction in flow stress occurred after annealing at 0° C, and the remainder at 20° C. This suggests that vacancy migration is responsible for the reduction in flow stress. J.Adam

539.21

6418. DEMONSTRATION OF THE FORMATION OF LITHIUM INSIDE A NEUTRON-IRRADIATED CRYSTAL OF LiF.
M.Lambert and A.Guinier.
C.R. Acad. Sci. (Paris), Vol. 246, No. 11, 1678-80 (March 17, 1958). In French.

The X-ray diffraction pattern of a LiF crystal irradiated with neutrons (dose between 0.6 and 1×10^{19} neutrons/cm^2) was found to contain sharp spots close to the 200 and 111 spots of LiF, in addition to the usual diffuse streaks. These spots can be interpreted as due to grains of face-centred cubic metallic Li. They disappear on

heating to 200°C, but on cooling numerous other sharp but faint spots appear, these corresponding to grains of the normal body-centred cubic metal whose orientation is fixed by the LiF lattice. On heating to 200°C this diffraction pattern also disappears, but it reappears on cooling. A.B.Lidiard

539.21

6419. FAST NEUTRON EFFECTS IN TETRAGONAL BARIUM TITANATE. M.C.Wittels and F.A.Sherrill.
J. appl. Phys., Vol. 28, No. 5, 606-9 (May, 1957).

Tetragonal $BaTiO_3$ is transformed into cubic $BaTiO_3$ as a result of irradiation with fast neutrons at a temperature of approximately 100°C. Sufficient atomic displacements are produced by bombardment with an integrated fast neutron flux of 1.8×10^{20} n/cm² so that tetragonal single crystals (c_0 = 4.0349 A and a_0 = 3.9923 A) expand anisotropically to form perovskite-type cubic single crystals with a_0 = 4.0824 A. The irradiated material remains cubic to the lowest temperature of measurement, 78°K, showing none of the low-temperature phase-transitions of unirradiated $BaTiO_3$, and after annealing at 1000°C the crystal remains cubic but with a reduced lattice parameter. X-ray, thermal, and optical methods were employed in studying these effects. A.

539.21

6420. DAMAGE TO SILICON PRODUCED BY BOMBARDMENT WITH HELIUM IONS. U.F.Gianola.
J. appl. Phys., Vol. 28, No. 8, 868-73 (Aug., 1957).

Some of the effects of bombarding a silicon single crystal surface with 3×10^4 eV helium ions were examined experimentally. The surface recombination velocity was found to be increased by more than two orders of magnitude, but could be restored to its original value by the removal of approximately 1 μ of surface material. This is believed to correspond to the total depth of material affected by the bombardment, and is in fair agreement with a theoretical estimate of the range of the helium ions. Electron diffraction data shows that the effect of bombardment is to convert the surface layer to a quasi-stable amorphous form, which may be partially restored to the crystalline state upon annealing. The amorphous material is soluble in aqueous hydrofluoric acid, and its thickness was measured by an interferometric technique. It is found to be approximately one tenth of the total thickness of silicon affected, depending on the bombardment dosage. The effect of annealing upon the diode characteristics of point contact diodes made with bombarded silicon were studied. The general result is that the characteristics tend to revert to those of an unbombarded diode, as expected from the electron diffraction data. These experiments are discussed in terms of radiation damage theory. A.

539.21 : 537.311.33

6421. EFFECT OF IRRADIATION ON THE HOLE LIFETIME OF N-TYPE GERMANIUM.
O.L.Curtis, Jr, J.W Cleland, J.H.Crawford, Jr and J.C.Pigg.
J. appl. Phys., Vol. 28, No. 10, 1161-5 (Oct., 1957).

The minority carrier lifetime of germanium is very sensitive to certain types of irradiation. The results of irradiating large single crystal samples of n-type germanium with fast neutrons and Co^{60} gamma rays are presented and discussed. Lifetime was determined from a transient measurement of the decay of holes following an injection pulse. The effect of initial carrier concentration has been considered. According to the James—Lark-Horovitz model, four energy levels are introduced by irradiation into the forbidden band of germanium, one above and three below the centre of the band. Using the upper level, a one level recombination model serves to explain the experimental results approximately. The determination of the recombination level agrees well with the position of the first ionization level of the interstitial produced by irradiation at about 0.2 eV below the conduction band. On this basis, the effective cross-section for hole capture by these recombination centres is found to be about 4×10^{-15} cm² and 5×10^{-16} cm² for neutron and gamma irradiated germanium, respectively. A lower level may also be responsible for the recombination process. A.

539.21 : 539.434

6422. INFLUENCE OF IRRADIATION ON CREEP. G.Schoeck.
J. appl. Phys., Vol. 29, No. 1, 112 (Jan., 1958).

Attention is drawn to the fact that the influence of neutron irradiation on the creep rates of non-fissionable metals will depend on temperature; at low temperatures one expects a (small) decrease in the creep rate, whereas at high temperatures an increase in the creep rate is expected. By means of a theoretical argument it is concluded that this increase might be most easily observed at temperatures near half the melting temperature and at fluxes of about or more than 10^{13} fast neutrons cm^{-2} sec^{-1}. R.Bullough

539.21 : 539.3

6423. THE EFFECT OF NEUTRON IRRADIATION ON THE MECHANICAL PROPERTIES OF COPPER AND NICKEL.
M.J.Makin.
J. Inst. Metals, Vol. 86, Pt 10, 449-55 (June, 1958).

The effect of neutron irradiation at 100°C with 5×10^{19} neutrons/cm² on the mechanical properties of annealed polycrystalline copper and nickel was studied at a variety of temperatures. The yield stress of both metals is increased by the irradiation, and the increase is markedly temperature-dependent, being very much greater at low temperatures than at high. The temperature variation in yield stress after irradiation is a reversible phenomenon and is not due to an annealing effect at the higher temperatures. The rate of work-hardening is greatly reduced by the irradiation, especially at low strains. The ultimate tensile strength is increased and the elongation to fracture is reduced by irradiation. The results are discussed in terms of the possible mechanisms of irradiation-hardening. A.

539.21

6424. ENERGY TRANSFORMATION OF X-RAY PHOTO-CHEMICAL PROCESSES IN KBr CRYSTALS. E.Feldtkeller.
J. Phys. Chem. Solids, Vol. 4, No. 1-2, 50-7 (1958). In German.

An investigation was made of the percentage converted into heat, of the absorbed energy in a KBr single crystal irradiated by X-rays. For pure KBr this rate amounts to about 90%. For hydrated KBr the heat yield at room temperature in the beginning of irradiation is about 3% lower than for the pure crystal, and approaches that of pure KBr during coloration. Deductions for the portion of radiating and radiationless electron transitions involved are discussed. By the same method the heat produced by transitions of optically excited F-centres to the ground state was measured in KCl. The results agree with the fluorescence yield of the same process measured by Becker and Pick. A.

539.21

6425. EVIDENCE FOR THE TRAPPING OF INTERSTITIAL ATOMS IN IRRADIATED TUNGSTEN. M.W.Thompson.
Phil. Mag. (Eighth Ser.), Vol. 3, 421-3 (April, 1958).

Irradiation for 1 hr in the BEPO reactor at −196°C produced an increase in residual electrical resistance which began to anneal out at about 100°C. Irradiation for 12 hr gave an increase which began to anneal at −40°C, and which annealed more rapidly at higher temperatures than for the lower dose. This is explained by assuming that interstitial atoms can be trapped at impurities: in the low-dose experiment there are more impurities than interstitials and the annealing is difficult, but in the high-dose experiment the traps are saturated and most of the interstitials remain free to anneal out. A.B.Lidiard

539.21

6426. X-RAY STUDY OF DEUTERON-IRRADIATED COPPER NEAR 10°K. R.O.Simmons and R.W.Balluffi.
Phys. Rev., Vol. 109, No. 4, 1142-52 (Feb. 15, 1958). [This article was incompletely printed in No. 2, 335-44 (Jan. 15, 1958)].

Precise measurements of lattice expansion of high-purity copper held near 10°K during deuteron bombardment were made using a rotating single-crystal method. An expansion of $(4.1 \pm 0.2) \times 10^{-21}$ per 7 MeV deuteron/cm² was found. No broadening of the Laue—Bragg intensity around the (4,0,0) reciprocal lattice point occurred. These effects are broadly consistent with the introduction of small point centres of dilation. On the assumption that the damage consists of Frenkel defects, published calculations for the volume expansion due to interstitial atoms and vacant lattice sites in copper and the observed expansion lead to a concentration of defects which is only 0.08 to 0.22 of that predicted by the simple theory of displacement. Several independent measurements of inhomogeneity of the damage indicated an E^{-1} variation of the probability of lattice-atom displacement with deuteron energy E in agreement with the simple theory. The ratio of resistivity increase to lattice expansion is 7×10^{-10} ohm cm for such deuteron irradiation. Use of the empirical defect concentrations then gives a value for the resistivity of 1% of Frenkel defects as 2.1 to 5.6×10^{-6} ohm cm. Thermal recovery of the expansion in the temperature range from 10° to 302°K was measured. It was strikingly similar to the recovery of electrical resistivity changes produced by deuteron irradiation. About 55% of the recovery occurred in a range below 42°K and the recovery was essentially complete at 302°K. Whatever the activating mechanism may be in each stage of recovery, the observed recovery appears predominantly due to mutual annihilation of interstitials and vacancies. A.

539.21

6427. DISCRETE RECOVERY SPECTRUM BELOW 65° K IN IRRADIATED COPPER. J.W.Corbett and R.M.Walker.
Phys. Rev., Vol. 110, No. 3, 767-8 (May 1, 1958).

Electrical resistivity measurements were made on samples irradiated with 1.4 MeV electrons at approx. 20° K. Post-irradiation annealing shows four recovery stages below 65° K. J. Adam

539.21

6428. FAST-NEUTRON-INDUCED CHANGES IN QUARTZ AND VITREOUS SILICA. W.Primak.
Phys. Rev., Vol. 110, No. 6, 1240-54 (June 15, 1958).

The course of the changes produced by exposure in nuclear reactors and the subsequent alteration of the radiation-induced property changes caused by heating were followed by measuring the dilatation, refractive index, rotary power and birefringence. The fast-neutron dosages determined by a comparison of radiation damage in several substances are used to give a consistent scale for presenting the effects seen from the initial changes to nearly the saturation state, despite the many irradiation facilities used for the work. The property changes resulting from heating specimens irradiated to various extents are given. The damaging phenomena are examined in terms of the interaction of the scattered atoms with the silica structure, and the annealing phenomena in terms of the behaviour of the anticipated structural changes. On the basis of the effect of displaced atoms and thermal spikes on solid structures there are delineated a number of classes of radiation damage among insulators. For one of these, silica is taken to be the prototype. Thermal spikes cause the displaced atoms to be accommodated by a local deformation, which is depicted as analoguous to the rapid inversions in which a minor reorientation of the Si-O tetrahedra occurs without extensive disruption of the structure. The resulting gradually accumulating disorder is considered the basic formulation of a metamictization for which the damaging of quartz thus becomes the simplest example. The same basic processes are considered to take place in vitreous silica; but since the substance is already disordered, the changes which take place are minor, the slight compacting of the structure evidently representing mainly the partial freezing-in of a high-temperature state produced by the thermal spike.

A.

539.21 : 541.15

PRODUCTION OF COLLOIDAL SODIUM IN NaCl BY IONIZING RADIATION. See Abstr. 5509

STRUCTURE OF SOLIDS

539.211 : 539.2

6429. THE NUCLEATION OF DISLOCATION LOOPS DURING CLEAVAGE. S.Amelinckx.
Phil. Mag. (Eighth Ser.), Vol. 3, 653-5 (June, 1958).

A technique for the decoration of dislocations in KCl has been developed which leaves the dislocation pattern largely unaltered. By this means the generation of dislocation loops at a slowly propagating crack front was demonstrated. A.B.Lidiard

539.211

6430. CRACK FORMATION IN MAGNESIUM OXIDE SINGLE CRYSTALS. R.J.Stokes, T.L.Johnston and C.H.Li.
Phil. Mag. (Eighth Ser.), Vol. 3, 718-25 (July, 1958).

Experimental evidence is presented which lends direct support to the Stroh mechanism for crack formation. After a magnesium oxide crystal was compressed about 3%, it was observed that minute cracks had been formed in the region of a kink band generated by non-homogeneous plastic strain. These cracks lay on conjugate {110} slip planes and not on the usual {100} cleavage planes. They extended in the form of [001] direction slits running right through the crystal.

A.

539.215.08

6431. THE SAMPLING EFFICIENCY OF THE THERMAL PRECIPITATOR. H.H.Watson.
Brit. J. appl. Phys., Vol. 9, No. 2, 78-9 (Feb., 1958).

Experiments were carried out to test the validity over an extended range of an equation for the recording efficiency in terms of the velocity of a particular particle size, the velocity of air entering the orifice, and a parameter p (p is related to particle density and diameter, the viscosity of air, and the length of gap between the hot wire and cover glasses). Good agreement of the data with this equation is claimed. S.J.Gregg

539.215.2

6432. OBSERVATION OF THE GRAIN BOUNDARY IN SOAP BUBBLE RAFT. III. THE GRAIN BOUNDARY IN VIBRATING STATE. E.Fukushima and A.Ookawa.
J. Phys. Soc. Japan, Vol. 12, No. 1, 139-46 (Feb., 1957).

For Pt II see Abstr. 5015 (1954). Observations were made on the static as well as the dynamical features of the grain boundary in the bubble raft under vibration. In the process of increasing the reduced temperature, the diffused hole (B-type) boundary transforms itself to the dislocation (A-type or C-type) boundary, and vice versa. The transformation temperature varies, depending on the angle of misorientation between the grains. It is suggested that the marked correspondence between the dislocation theory and experiment as to the grain boundary energy is a natural consequence. There is a discussion on the molecular mechanism of the transformation between the incoherent and the coherent boundaries, and on the probable causes of the hysteresis effect observed. A.

539.217 : 535.43 : 537.531

6433. SCATTERING BY AN INHOMOGENEOUS SOLID. II. THE CORRELATION FUNCTION AND ITS APPLICATION.
P.Debye, H.R.Anderson, Jr and H.Brumberger.
J. appl. Phys., Vol. 28, No. 6, 679-83 (June, 1957).

For Pt I, See Abstr. 5373 (1949). Experiments on the angular intensity distribution of X-rays scattered by porous materials (hole structures) in the range of small angles are described. It is shown that the scattering can be characterized by an exponential correlatio function in the case of a distribution of holes of random shape and size in solids; a theoretical derivation of the exponential function is given for this case. When the correlation function is an exponential, the rule holds that the reciprocal square root of the scattered intensity is a linear function of the square of the scattering angle. The specific surface of the material is determined by the slope of this straight line. Specific surfaces of a number of compositions are calculated from their experimental correlation functions and compared to surfaces based on adsorption measurements. A.

539.217

6434. THEORY OF DIFFUSION CONSTANTS IN INTERSTITIAL SOLID SOLUTIONS OF B.C.C. METALS. A.Ferro.
J. appl. Phys., Vol. 28, No. 8, 895-900 (Aug., 1957).

An attempt is made to evaluate the activation energy of interstitial diffusion in body-centred cubic metals on the basis of the distortion energy necessary to open one of the flat interstitial cavities $(\frac{1}{2}\,0\,0)$ adjacent to an occupied one to a size equal to the diameter of the interstitial atom. The frequency on which the diffusion process depends, and hence the frequency value to be used in calculating D_0, is simply the maximum frequency of the lattice along the (100) direction. The results obtained for Q and D_0 agree satisfactorily with the experimental data and thus show clearly the dependence of the activation energies Q on the elastic constants of the metal of the matrix and on the interstitial atom diameter. Moreover the theory confirms the origin of some observed relaxation effects still uncertain and the evaluation of the activation energies of interstitial atoms anchored around lattice defects such as dislocations.

A.

539.217

6435. SIMPLE GEOMETRIC MODEL FOR THE EFFECT OF POROSITY ON MATERIAL CONSTANTS. F.Euler.
J. appl. Phys., Vol. 28, No. 11, 1342-5 (Nov., 1957).

The effect of porosity on several material constants can be described by three types of empirical functions. One of these features linear increase from zero to unity of the relative bulk material constant when the relative density increases from $\pi/6$ to 1. An almost identical function results from application of a theoretical model with the following properties. (1) The porous compact is divided into two systems: first, isolated pores in a continuous solid matrix; second, solid grains mixed with continuous voids. (2) The geometry of both systems is assumed to be a cubic array of equal spheres. With this simplification, the relative bulk material constants of each system are calculated as functions of the relative density. The equations obtained are valid for those material constants which are ratios of corresponding fluxes and forces in the sense defined by Maxwell (e.g., the electric conductivity). (3) Weight factors for the presence of either system are introduced. (4) The weight factor for the system of isolated pores is assumed equal to the relative bulk material constant of the total compact for all values of relative density. The implications of this model to the mechanism of sintering are discussed. A.

539.219

6436. THEORY OF ORDER IN TERNARY ALLOYS. I.
K.F.Wojciechowski.
Acta metallurgica, Vol. 6, No. 6, 396-400 (June, 1958).

The theory of order in ternary alloys as generalization of a theory of binary alloys is given. It is shown that for the description of the long-range order in ternary alloys a set of linear independent long-range parameters is needed. The number of these long-range parameters is fully determined. For the calculation of configurational energy, the method of finding the average number of pairs of atoms of mutual distance r is given. The long-range order is considered on basis of generalization of the Bragg—Williams theory. The general discussion of the thermodyanmic equilibrium conditions of ternary alloys and the application of this theory to the Heusler alloy of composition Cu_2MnAl is also quoted. A.

539.219

6437. THE CONSTITUTION OF NICKEL-GALLIUM ALLOYS IN THE REGION 0-35 ATOMIC % GALLIUM.
W.B.Pearson and D.M.Rimek.
Canad. J. Phys., Vol. 35, No. 10, 1228-34 (Oct., 1957).

The equilibrium diagram of nickel—gallium alloys has been revised to include a newly discovered Ni_3Ga superlattice which forms peritectically at 1210°C. The new work shows that there is a very close resemblance between the Ni—Al and Ni—Ga systems in the nickel-rich region. A.

539.219

6438. GRAPHICAL ANALYSIS OF DIFFUSIONLESS PHASE CHANGES — THE CUBIC TO TWINNED ORTHORHOMBIC TRANSFORMATION. D.S.Lieberman, T.A.Read and M.S.Wechsler.
J. appl. Phys., Vol. 28, No. 3, 532-41 (May, 1957).

A simplified method of calculating the crystallographic features of a diffusionless (martensitic) phase change is described and applied to the gold—cadmium alloy cubic—orthorhombic transformation. Use of the method requires a knowledge of the initial and final crystal structures and the specification of the crystallographic plane and direction of the inhomogeneous shear. It is based on the requirement that after partial transformation the interface between the two phases be free from stress on a macroscopic scale. The method involves representing on a stereographic net (a) the loci of directions in the original phase unchanged in length by the structure change per se and (b) the loci of directions unchanged in length by the inhomogeneous shear. The intersection of these loci determine possible undistorted interface planes. Excellent agreement with experimental observations is found when the method is applied to the cubic—orthorhombic transformation in gold—cadmium alloys. A.

539.219

6439. PRECIPITATION OF Cu IN Ge. II. SUPERSATURATION EFFECTS. A.G.Tweet.
Phys. Rev., Vol. 111, No. 1, 57-66 (July 1, 1958).

For previous Pt see Abstr. 5670 (1957). Studies were made on the precipitation kinetics of Cu from supersaturated solid solution in Ge crystals with dislocation densities $< 100/cm^3$. It was found that the precipitation rates are very strongly dependent upon the degree of supersaturation. It is believed this is evidence for the nucleation of the precipitate particles upon a single type of nucleation site, whose identity has not been established. An attempt is made to fit the experimental data to the simple theory of nucleation in which σ, the surface tension in the phase boundary between precipitate and host lattice, and E_p, the structure-sensitive increase in strain energy in the crystal upon formation of the precipitate, are parameters. It is found that the data can be fitted by $\sigma \cong 500 \pm 50$ ergs/cm^2, and $E_p \cong (1 \pm 1) \times 10^{-13}$ erg/atom, assuming spherical precipitates. No other information about these quantities is available for comparison. An appendix gives a simplified treatment of Ham's derivation of the kinetic law for diffusion-limited precipitation upon spherical precipitate particles, which relates the observed precipitation rate to the number of precipitate particles. Theory and experiment are in reasonable agreement. A.

539.219

6440. PRECIPITATION OF Cu IN Ge. III. QUENCH EFFECTS IN NEARLY PERFECT CRYSTALS. A.G.Tweet.
Phys. Rev., Vol. 111, No. 1, 67-71 (July 1, 1958).

Studies were made of the effects of rapid quenching upon the precipitation rate of Cu in Ge. It is shown that electrically active metastable centres with energies very near the valence band are formed in the early stages of heat treatment of Cu-doped Ge at 500°C and below. These centres are found in concentrations up to $\sim 10^{15}/cm^3$ in samples with few dislocations. Their stability is very much greater in quenched samples than in slow-cooled specimens, and it increases with decreasing temperature. Evidence also is presented for the formation at the beginning of heat treatment of electrically neutral centres. The presence of metastable centres can completely determine the precipitation kinetics in quenched samples with low dislocation density at temperatures below approximately 425°C. A.

539.219 : 530.162

6441. A NEW APPROXIMATE METHOD OF CONSTRUCTING CONFIGURATIONAL PARTITION FUNCTIONS OF COOPERATIVE ASSEMBLIES. T.M.Wang, H.C.Hsu and T.S.Chang.
Scientia Sinica, Vol. 7, No. 3, 313-28 (March, 1958).

This paper proves rigorously that the configurational free energy F of a binary solid solution inhabiting a lattice of the type AB is linear in certain coordination numbers of the lattice defined through the so-called neighbour matrices. By writing F as a linear combination of such numbers, it is found that the coefficients may be obtained by studying the configurational free energies of the same solid solution, but with the sites now falling into groups, so that each group contains a small number of sites and the sites in different groups do not form nearest neighbours. Since the free energies of such solid solutions may be easily calculated, a new method of calculating free energies of solid solutions inhabiting actual lattices is obtained. This method allows immediate generalization to various cases. A.

539.219 : 548.5

CRYSTALLIZATION OF METALLIC ALLOYS. See Abstr. 5517

539.231

6442. ANALYSIS OF LOW-ENERGY SPUTTERING. E.Langberg.
Phys. Rev., Vol. 111, No. 1, 91-7 (July 1, 1958).

It is postulated that for low-energy sputtering the interatomic energy and distance relation can be represented by a Morse curve, and that the energy transfer in the lattice proceeds essentially by two-particle (i.e., binary) collisions. Based on these assumptions, a two-collision sputtering mechanism near the threshold is described. Under optimum energy transfer conditions, the analysis of this process gives the ion energy for a sputtering threshold of a surface particle tied by N bonds. It is shown further than under a prolonged ion bombardment a surface contains particles with a number of bonds N, ranging from a maximum determined by a complete surface to a minimum determined by inaccessible bonds to underlying surface layers. Based on this information, the form of the sputtering yield-energy function is derived, consisting of a parabolic and a linear part. Predicted and experimental Pt—Hg^+ curves are compared, and the agreement is excellent. Two thresholds are defined: The lower threshold is the actual intercept of the yield curve, whereas the upper threshold corresponds to the intercept of the linear part of the yield curve. The two thresholds are computed for 20 metals bombarded by the Hg^+ ion. The agreement with experimental values and the empirical threshold formula of Wehner is satisfactory. A.

539.231 : 538.23

COERCIVE FORCE AS FUNCTION OF THICKNESS OF Ni—Fe FILMS. See Abstr. 6057

539.232 : 531.715 : 535.417

THICKNESS MEASUREMENT OF THIN TRANSPARENT FILMS. See Abstr. 5809

539.234 : 535.345

6443. BORON FILMS. D.Barnes, R.B.Mackenzie and R.Aves.
Atomic Energy Res. Establ. (Harwell), Mem. R/M 125, 4 pp.(1957).

A brief description is given of a method of depositing boron films by simple evaporation, using electron bombardment as a means of heating the boron. Spectral transmission curves are given for chemically pure films, and are compared with curves for contaminated films. A.

539.234 : 535.393

6444. THE EFFECT OF GETTERING ON THE REFLECTIVITY OF ALUMINIUM FILMS. L.Holland.
Brit. J. appl. Phys., Vol. 9, No. 8, 336-7 (Aug., 1958).

Aluminium films evaporated on glass from a single vapour source are more optically absorbing at high angles of vapour incidence if the films are slowly deposited or prepared in a poor vacuum. The rise in the optical absorption with vapour incidence angle is attributed to the degree of gas contamination of the growing film increasing as the deposition becomes more oblique. Such an effect could arise from a greater ratio of the number of gas molecules to vapour atoms combining at the receiver in regions of low vapour

intensity. The reflectivities of aluminium films prepared at different gas pressures and rates of deposition show qualitative agreement with the hypothesis when plotted as a function of vapour incidence angle. The simple theory advanced is not applicable at gas pressures above 1 μ mercury because the vapour atoms are scattered by gas molecules before striking the receiver. A.

539.27

6445. THE ANALYSIS OF PARTICLE COUNTS BY THE SPRAY-DROP METHOD. K.I.Williamson and W.B.Taylor.
Brit. J. appl. Phys., Vol. 9, No. 7, 264-7 (July, 1958).

The spray-drop method is used in electron microscopy to determine the concentration of particles in an unknown suspension. The usual analysis procedure is criticized and a better one is given and justified. A test is included to check the presence of variations in the data due to causes other than purely random ones, e.g. inadequate mixing. The test is applied to artificial sets of data to illustrate its usefulness. A.

539.27

6446. ELECTRON DIFFRACTION INVESTIGATION OF POLYMERS. IV. STUDY OF THE STRUCTURAL CHANGES IN POLYTRIFLUORCHLORETHYLENE IN THE TEMPERATURE RANGE OF MELTING OF THE CRYSTALS.
A.V.Ermolina, G.S.Markova and V.A.Kargin.
Kristallografiya, Vol. 2, No. 5, 623-7 (1957). In Russian.

The diffraction of electrons by films of crystalline and fused polytrifluorchlorethylene was studied at temperatures up to the melting point. The results are interpreted in terms of the interatomic and intermolecular distances in the polymer. In the amorphous state polytrifluorchlorethylene is a highly ordered liquid, and the degree of ordering increases on crystallization.

R.F.S.Hearmon

539.27 : 539.2

6447. MOIRÉ PATTERNS ON ELECTRON MICROGRAPHS, AND THEIR APPLICATION TO THE STUDY OF DISLOCATIONS IN METALS. G.A.Bassett, J.W.Menter and D.W.Pashley.
Proc. Roy. Soc. A, Vol. 246, No. 1246, 345-68 (1958).

The moiré patterns are obtained on transmission electron micrographs from pairs of overlapping single-crystal films of metals, prepared in a suitable manner. The mode of formation of these moiré patterns were interpreted in terms of the kinematical theory of electron diffraction, and the relation between the patterns and the individual lattices was considered. It is shown that both edge and screw dislocations in one of the crystals will give rise to terminating half-lines in the moiré pattern: the number of these terminating half-lines has been deduced, for the f.c.c. system, for any general dislocation line. The results are completely consistent with the observations, and several examples of dislocations are illustrated in the paper. Partial dislocations and stacking faults are also observed. The moiré patterns were also used to record dislocation movements. The smallest periodicity which the authors have so far succeeded in resolving in the electron microscope is a moiré pattern of spacing 5.8 A, obtained from overlapping nickel and gold crystals. The potentialities and limitations of the technique of moiré patterns are discussed. A.

ELASTICITY. STRENGTH. RHEOLOGY

539.32

6448. EFFECT OF IRRADIATION ON DYNAMIC MECHANICAL PROPERTIES OF 6-6 NYLON.
C.W.Deeley, A.E.Woodward and J.A.Sauer.
J. appl. Phys., Vol. 28, No. 10, 1124-30 (Oct., 1957).

Measurements of elastic modulus and mechanical loss at audio-frequencies were obtained on irradiated and nonirradiated specimens of polyhexamethylene adipamide over a broad temperature range extending from 80°K to 600°K. The irradiations were carried out at the Brookhaven and Penn State Reactors. The internal friction spectrum of unirradiated nylon 6-6 contains at least four peaks corresponding to different mechanisms being invoked as the temperature is raised. With irradiation doses from 0.3×10^{18} nvt to 5.5×10^{18} nvt, significance changes in the dispersion regions occur. At temperatures above the main softening region, an increase in modulus with temperature is found. This is evidence of rubber-like behaviour and is accounted for by the introduction of cross-links resulting from ionization and free radical formation produced by the irradiation. At high irradiation doses the percent cross-linking appears to become independent of dose. The various effects found are discussed in terms of molecular forces and mobility of chain segments. A

539.32

6449. SINGLE-CRYSTAL ELASTIC CONSTANTS OF INDIUM.
D.R.Winder and C.S.Smith.
J. Phys. Chem. Solids, Vol. 4, No. 1-2, 128-34 (1958).

The elastic constants of tetragonal indium were measured by the ultrasonic pulse-echo method. Single crystals were cut so that pulses propagated in the approximate directions [100], [110], and [011] respectively. The nine wave velocities allow the six constants to be determined with three internal checks. If indium is regarded as a tetragonally deformed f.c.c. structure, the constants may be referred to axes coincident with the deformed cubic axes, and in this reference frame the values (expressed in units of 10^{11} dyne cm^{-2}) obtained are: $C_{11} = 4.45$, $C_{33} = 4.44$, $(C_{11}-C_{12})/2 = 0.253$, $(C_{11}+C_{33})/4 - C_{13}/2 = 0.197$, $C_{44} = 0.655$, $C_{66} = 1.22$. The constants and combinations representing stiffness to shear are low, and are anisotropic in contrast to those for aluminium. The microscopic parameters, particularly those pertaining to overlap electrons, which appear in the calculation of Leigh for aluminium can be adjusted to account for these features of indium. A.

539.371 : 539.2

INFLUENCE OF DEFORMATION ON KINK BAND FORMATION.
See Abstr. 6411

539.373 : 548.5

6450. ON THE OCCURRENCE OF SLIP IN DIAMOND.
S.Tolansky, A.Halperin and S.H.Emara.
Phil. Mag. (Eighth Ser.), Vol. 3, 675-9 (July, 1958).

Linear discontinuities strictly in (1,1,1) planes were observed on the natural octahedral faces of a diamond. The lines are studied optically. The characteristics of the lines suggest that they originate in slip which could well have occurred while the diamond was still growing and presumably hot. The slip hypothesis is the only reasonable one which accounts for the observed characteristics of the lines. A.

539.374 : 539.32 : 536.413

6451. INFLUENCE OF PLASTIC DEFORMATION ON EXPANSIVITY AND ELASTIC MODULUS OF ALUMINUM.
M.J.Hordon, B.S.Lement and B.L.Averbach.
Acta metallurgica, Vol. 6, No. 6, 446-53 (June, 1958).

Tensile plastic deformation of polycrystalline aluminium causes an increase in the thermal expansion coefficient and a corresponding decrease in the elastic modulus. These properties vary with the deformation in a complex way and the changes were interpreted in terms of the introduction of two types of defects in the deformed lattice. A minimum in the elastic modulus and a corresponding maximum in the expansivity at small plastic strains (about 0.1%) were associated with the movements of mobile dislocations. A subsequent decrease in the modulus and an increase in the expansivity at large strains (about 10%) were associated with the production of vacancies during deformation. A.

539.374

6452. REGULARITIES IN PLASTIC FLOW OF LEAD AND TIN UNDER CONDITIONS OF PURE SHEAR.
V.I.Likhtman and V.S.Ostrovskiĭ.
Dokl. Akad. Nauk. SSSR, Vol. 119, No. 3, 484-7 (1958). In Russian.

Samples of polycrystalline metal are given the shape of round plates and are subjected to simple shear by rotating the outer parts relatively to the centre in an apparatus similar to that used by Andrade and Jolliffe (Abstr. 6096/1952). Grooves are cut into the plates in order to make the shearing stress uniform. Experimental results are shown by plotting the rate of shear (creep) against the shearing stress. It is seen that flow begins at stresses which are higher than a certain yield value which is for both metals somewhat smaller than 0.1 kg/mm^2. A coefficient of viscosity is defined as the excess of stress over the yield value divided by the rate of shear. It is found that the viscosity is nearly independent of stress over a range of 3 to 4 times the yield value. At higher stresses viscosity decreases rapidly. R.Eisenschitz

539.382 : 534.321.9 : 534.2

6453. ELASTIC PROPERTIES OF ICE. V.V.Bogorodskiĭ.
Akust. Zh., Vol. 4, No. 1, 19-23 (1958). In Russian.

The application is examined of a pulsed ultrasonic method for determining Young's modulus of ice. Experiments were carried out on fresh-water ice at various places and at the locations of the drifting station "SP-4". The apparatus employed is illustrated. For fresh-water ice basins the results show a practically linear variation of velocity of propagation with temperature.

C.R.S.Manders

539.382 : 539.42

6454. THE TENSILE PROPERTIES OF URANIUM FROM ROOM TEMPERATURE TO 600°C. N.H.Hancock.
Atomic Energy Res. Establ. (Harwell), Rep. M/R 1156, 6 pp. (1957).

Tensile tests were made to determine the variation from room temperature to 600°C of proof stresses, ultimate tensile strength, Young's modulus, and elongation, of two casts of uranium and of a uranium 4.9% molybdenum alloy. The variation of the ratio of Brinell hardness to ultimate tensile strength and proof stresses is also given for the two nominally pure uranium casts. A.

539.382

6455. A MODIFICATION OF TAYLOR'S METHOD FOR CALCULATING THE PLASTIC STRESS—STRAIN RELATION IN FACE-CENTRED CUBIC CRYSTALS.
H.Payne, S.J.Czyzak, J.H.Greiner and T.H.Lin.
J. Mech. Phys. Solids, Vol. 6, No. 4, 314-20 (July, 1958).

A method is presented for determining the stress—strain relation in the plastic region for polycrystalline materials from empirical data on slipping in the corresponding single crystal. Results of calculations for uniaxial loading are presented. A.

539.383

6456. SINGLE CRYSTAL LATTICE ROTATION DURING COMPRESSION. R.L.Fleischer.
J. Mech. Phys. Solids, Vol. 6, No. 4, 301-6 (July, 1958).

It is shown that lattice rotation during compression of a single crystal can be the reverse of that observed in tension, rather than the slip-plane rotation predicted and observed by Taylor (Abstr. 207/1928). A.

539.4

6457. PROBABILITY DISTRIBUTION AND CORRELATION OF SHEAR STRESS IN A CRYSTAL. G.Barsch.
J. Phys. Chem. Solids, Vol. 4, No. 1-2, 27-49 (1958). In German.

The distribution functions for the local statistical variables in a crystal (displacements, strains, stresses) are given and the second moments calculated by means of Debye's approximation. The range of correlation is about one lattice constant. The variances of new variables obtained by averaging the local variables over some fixed volume are calculated for the case of shearing stresses. In the classical limit these variances increase proportionally to the reciprocal volume and are independent of the shape of the volume and of the correlation of the local variables. At absolute zero the zero-point fluctuations behave similarly if the extension of the volume in one or more dimensions does not exceed a few lattice constants. For volumes of macroscopic size the variances increase more rapidly than proportionally with reciprocal volume and the influence of the correlation becomes negative. These results essentially remain unaltered if the lattice spectrum is considered. An as application, Becker's formula, denoting the distribution function for the shearing stresses in a volume, is derived from statistical principles. The formula obtained in the classical limit essentially agrees with the common thermodynamic expression of Becker's formula. For absolute zero, however, it leads to an expression of the variance of the zero-point motion which, for volumes of atomic size, is comparable with the contribution of classical motion. A.

539.4.016.2

6458. DISLOCATION MOBILITY AND RELEASE OF COLD WORK IN CADMIUM. R.Kamel and E.A.Attia.
J. appl. Phys., Vol. 28, No. 11, 1365 (Nov., 1957).

Internal friction and elastic modulus changes were measured, to study dislocation mobility in cold-worked cadmium of high purity, subjected to various heat treatments. At each annealing temperature the internal friction shows a characteristic sharp peak when plotted against annealing time. A heat of activation of 17.5 kcal/mole can be associated with polygonization, regarded as a rate process.
J.G.Oldroyd

539.41

6459. MECHANICAL BEHAVIOR OF PLASTICS.
I.J.Gruntfest, E.M.Young,Jr and W.Kooch.
J. appl. Phys., Vol. 28, No. 10, 1106-11 (Oct., 1957).

The applicability of Nutting's equation of the mechanical behaviour of some soft plasticized polyvinyl chloride preparations noted by Dyson in creep experiments is further demonstrated by force—length measurements at constant rate of strain. This suggests new criteria for the characterization of soft plasticized PVC. For example, in a stretching experiment in which the sample is subjected to a strain (L − 1) which increases linearly with time (t) at the rate (R), definition of "modulus" as the limit at small strains of the ratio of the force (F) to the strain is clearly inappropriate. That is, when

$$L - 1 = GF^m t^n,$$

$$\lim_{L-1 \to 0} \left(\frac{F}{L-1}\right) = (L-1)^{(1-n-m)/m} R^{n/m} G^{-1/m}$$

which may be zero or infinite and also depends on the strain rate. Some even more general force—length—time relationships for plastics are discussed which have been found useful for predicting the conditions of tensile failure. More complicated relationships of particular interest provide for the possibility of force—time superposition of creep curves. Published creep data are considered from this point of view. A.

539.42 : 539.216

6460. TIME DEPENDENCE OF MECHANICAL BREAKDOWN IN BUNDLES OF FIBERS. I. CONSTANT TOTAL LOAD.
B.D.Coleman.
J. appl. Phys., Vol. 28, No. 9, 1058-64 (Sept., 1957).

A previously published phenomenological theory of the statistics and time dependence of the creep failure of oriented polymeric filaments (Abstr. 7767/1956) is applied to bundles of filaments. The mathematical apparatus of the theory of stochastic processes is used to calculate relationships between the strength of filament bundles and the strength of their component filaments. The present paper is concerned with the case in which the total load on a given bundle is maintained constant in time. Two limiting idealized cases are discussed — bundles with no interfibre friction (called "ideal bundles") and bundles with very strong interfibre friction (called "tight bundles"). Only the first case is discussed rigorously. It is assumed throughout that the bundles are composed of filaments which have been randomly selected from a first-order ensemble. The principle mathematical result is that, subject to certain rather general conditions, in the limit as the numbers of filaments, N, becomes infinite the distribution of lifetimes for an ideal bundle becomes normal with a coefficient of variation that is proportional to $N^{-\frac{1}{2}}$. The present theory predicts an appreciable loss in strength upon the arrangement of filaments into bundles. A.

539.42 : 539.216

6461. TIME DEPENDENCE OF MECHANICAL BREAKDOWN IN BUNDLES OF FIBERS. II. THE INFINITE IDEAL BUNDLE UNDER LINEARLY INCREASING LOADS. B.D.Coleman and D.W.Marquardt.
J. appl. Phys., Vol. 28, No. 9, 1065-7 (Sept., 1957).

It is assumed throughout that the bundle is composed of filaments which have been randomly selected from a first-order ensemble for which the average lifetime under separate dead loads is an exponential function of the applied load. The differential equation which describes the breakdown of such a bundle was numerically investigated with a digital computer using a fourth order Runge—Kutta method. It was found that, throughout the practical range in rates of loading, the bundle's tensile strength (units of force at break per initial unit area) is about 90% of the strength of the individual filaments. It also was found that the strength of the bundle is approximately an increasing linear function of the logarithm of the rate of loading. A.

539.431

6462. FORMATION OF FATIGUE CRACKS. W.A.Wood.
Phil. Mag. (Eighth Ser.), Vol. 3, 692-9 (July, 1958).

The contours of the slip bands produced by fatigue straining of metals are viewed by a process of taper-sectioning and optical microscopy which permits effective magnifications of some 20 000 times. The observations indicate ways in which the slip bands may turn into cracks and start disintegration of the metal surface. They also show that the mechanism of deformation and failure changes as the amplitude of the cyclic straining increases, the general form of the fatigue S/N curve arising from superposition of two distinct mechanisms. The observations support the view that fatigue cracking is primarily a simple geometrical consequence of to-and-fro fine slip movements in the fatigue slip-bands. A.

539.434

6463. NOTE ON PAPER "ON CREEP AND RELAXATION".
I.L.Hopkins and R.W.Hamming.
J. appl. Phys., Vol. 28, No. 4, 742 (April, 1958).

See Abstr. 2692 (1958).

539.434

6464. CREEP OF ANNEALED NICKEL, COPPER, AND TWO NICKEL-COPPER ALLOYS. W.D.Jenkins and C.R.Johnson.
J. Res. Nat. Bur. Stand., Vol. 60, No. 3, 173-91 (March, 1958).

Creep tests were made in tension under constant loads at temperatures of 300°, 700°, and 900° F on initially annealed specimens of nickel, copper, and 70% Ni 30% Cu and 30% Ni 70% Cu alloys. Tests at 1200° F were also made on the nickel and the two alloys, but not on the annealed copper as the resistance to creep of copper is relatively low at this temperature. The investigation included a study of the influence of rate of loading on the creep stress and of prior thermal-mechanical history on the creep behaviour of the alloys at several selected temperatures. Contour and hardness surveys and metallographic examinations were also carried out on some of the fractured specimens to ascertain the effect of creep on the necking characteristics, hardnesses, and structures of the metals. A.

539.434

6465. THE EFFECT OF STACKING FAULT ENERGY ON LOW TEMPERATURE CREEP IN PURE METALS.
P.R.Thornton and P.B.Hirsch.
Phil. Mag. (Eighth Ser.), Vol. 3, 738-61 (July, 1958).

Experimental results obtained by studying the low temperature creep behaviour before and after a small stress change are interpreted in terms of barriers due to intersecting dislocations. Using the data available on the temperature dependence of the flow stress in conjunction with these experimental results, estimates of jog energies are derived and compared with values obtained from flow stress data alone. Relative dislocation widths for various metals are also deduced. From the theoretical analysis relating dislocation width to stacking fault energy, tentative values are suggested for the stacking fault energies of Au, Ag, Al, Ni, Pb, Zn, Cd, Co and Pt, relative to that of Cu. These values are in reasonable agreement with previous estimates where available, thus confirming the hypothesis that low temperature creep is controlled by the proposed mechanism. The significance of these results is discussed in terms of the exhaustion and work hardening theories of low temperature creep. It is shown that the experimental observation that the apparent activation energy is insensitive to stress and pre-strain can be explained quite naturally on theories based on stress-aided activation and that it does not invalidate such theories. A.

539.531

6466. INVESTIGATION OF THE HARDNESS ANISOTROPY OF SINGLE CRYSTAL PbS BY THE SCRATCH METHOD.
Yu.S.Boyarskaya.
Kristallografiya, Vol. 2, No. 5, 709-12 (1957). In Russian.

The hardness was measured as a function of scratching angle in the (100), (110) and (111) planes. The results are shown as polar diagrams. R.F.S.Hearmon

539.58 : 534.222.2

6467. STUDY OF THE COMPRESSION OF DENSE MEDIA BY RADIOGRAPHY OF A SINGLE SHOCK.
J.Dapoigny, J.Kieffer and B.Vodar.
C.R. Acad. Sci. (Paris), Vol. 245, No. 18, 1502-5 (Oct. 28, 1957). In French.

The whole compressibility curve for à material may be deduced from the radiograph of a single lateral shock wave, produced by a longitudinal detonation wave in explosive in contact with the longitudinal face of the specimen. Different points on the curved shock front correspond to different pressures, found by measuring the angle between the shock front and the detonation axis. Results are given for Me polymethacrylate, up to nearly 10^5 kg/cm^2. J.Hawgood

539.62

6468. ON THE FRICTION OF INFLATED RUBBER TIRES ON ICE. C.D.Niven.
Canad. J. Phys., Vol. 36, No. 5, 599-610 (May, 1958).

The friction on ice of some small inflated rubber tires was measured on a turntable in a cold room. When rolling-friction force was plotted against load, the relation was either linear or slightly curved away from the load axis; such curvature implies that Thirion's Law does not hold for rolling friction. On the other hand, when sliding-friction force was plotted against load the curvature was toward the load axis as would be expected if Thirion's Law applied. The coefficient of friction can go as low as 0.01 (or even lower) for a hard-pumped tire when the temperature is near 0°C, but at −1°C rolling friction on dry ice is quite appreciable. The results refer only to measurements at very slow speed. A.

539.62

6469. FRICTIONAL HEATING AND ITS INFLUENCE ON THE WEAR OF STEEL. N.C.Welsh.
J. appl. Phys., Vol. 28, No. 9, 960-8 (Sept., 1957).

High frictional temperatures during the dry or imperfectly lubricated rubbing of steel produce gross structural changes and intense hardening of the surface layers. In consequence of these changes the wear time curve shows a marked inflection, the wear rate of soft steel on soft steel diminishing by more than an order of magnitude as the hardened skin develops. The protective layer establishes itself more readily as the carbon content of the steel increases, a feature explained by the ease with which eutectoid pearlite transforms to austenite, and thence to martensite, during the rapid temperature cycle. By simulating the hot spots during wear by the thermal action of electric sparks, the hardness change is shown to be intensified by nitrogen or carbon absorbed from the atmosphere or lubricant. A.

539.621

6470. ROLE OF ATMOSPHERIC OXIDATION IN HIGH SPEED SLIDING PHENOMENA. M.Cocks.
J. appl. Phys., Vol. 28, No. 8, 835-43 (Aug., 1957).

An experimental study of the role of oxidation in inhibiting metallic interaction between metal surfaces sliding at high speeds (up to 66 m/sec) is described. Metallic interaction was detected by microscopic examination of the surface damage after sliding. By using hardened steel, information concerning surface temperatures was deduced from subsequent hardness measurements. At light loads the metal surfaces were severely torn, but at higher loads the tearing became less severe. Above a certain load, which depended on the speed, tearing was almost eliminated from at least one of the surfaces. Other experiments supported the conclusion that this was due to the increased oxidation associated with the greater frictional heating, and that severe wear at high loads was due to a process of oxide disintegration. Under these conditions the wear rate increased rapidly with increase in load or speed, whereas the wear associated with metallic tearing at light loads showed little increase with load, and decreased with increasing speed. The friction coefficient decreased with increasing load and with increasing speed. The shapes of the underlying bodies influenced the average surface temperatures and therefore the wear and surface damage and create differences even for a pair of mating surfaces. A.

539.89

6471. PHASE TRANSITION IN SOLID MERCURY. C.A.Swenson.
Phys. Rev., Vol. 111, No. 1, 82-91 (July 1, 1958).

A polymorphic transition in solid mercury which was initially discovered by Bridgman has been studied at lower temperatures and pressures than those previously used. The transition would occur at zero pressure and 79° K if these data are extrapolated. However, the transition begins to show time effects and large pressure hysteresis at much higher temperatures, and below 93° K it can only be made to run irreversibly and in the $\alpha-\beta$ direction, and then only upon the application of several thousand atm pressure. The changes in the molar volume with both temperature and pressure from 4.2° K to 200° K and from zero to 12 000 atm were determined in addition to the changes in the thermodynamic parameters at the transition. In particular, these results can be used to explain an anomaly which was found in work on the effects of pressure on the superconducting transition in mercury. A.

PHYSICAL CHEMISTRY

PHASE EQUILIBRIUM. CHEMICAL REACTIONS

541.124

472. EXCITATION OF NITRIC OXIDE BY ACTIVE NITROGEN. .Kaufman and J.R.Kelso.
. chem. Phys., Vol. 27, No. 5, 1209-10 (Nov., 1957).

An explanation of the colour change, and its spatial distribution, roduced by the addition to active nitrogen in increasing amounts nitric oxide is suggested in terms of the reactions:

$$NO + N(^4S, \text{active nitrogen}) \rightarrow N_2 + O$$
$$N + O + M \rightarrow NO^* + M \rightarrow NO + M + h\nu$$

xperiments in which $N^{15}O$ was introduced into N^{14} active nitrogen howed up only bands of $N^{14}O$ in support of these mechanisms.

R.W.Nicholls

541.126

473. ON THE REACTION OF CH_4^+ WITH CH_4. :.D.Wagner, P.A.Wadsworth and D.P.Stevenson.
. chem. Phys., Vol. 28, No. 3, 517 (March, 1958).

Mass spectrometric investigations are described in which the ross-sections for the formation of $CH_3D_2^+$, CD_4H^+, and CD_5^+ relative o that of CH_5^+ are measured. The results indicate that the activated omplex is $(CH_4.CH_4)^+$ rather than $(C_2H_8)^+$. W.Good

541.127 : 534.222.2

474. CALCULATION OF REACTION PROFILES BEHIND TEADY-STATE SHOCK WAVES. I. APPLICATION TO DETONA- ION WAVES. R.E.Duff.
. chem. Phys., Vol. 28, No. 6, 1193-7 (June, 1958).

A numerical procedure for the integration of an arbitrary ystem of kinetic equations subject to the constraints imposed by teady state shock hydrodynamics is described. The detonation pro- ile has been calculated for a $2H_2 + O_2 + Xe$ mixture at an initial ressure of 30 mm Hg. These conditions correspond to those used y Kistiakowsky and Kydd in a measurement of the wave profile. The alculated profile is in qualitative agreement with the measured one. he calculation provides empirical evidence that a frozen sound peed definition of the Chapman—Jouguet state cannot correspond o reality. A.

541.127.1 : 534.222.2

475. MEASUREMENT OF RATE CONSTANTS OF FAST REACTIONS IN A SUPERSONIC [M = 2] NOZZLE. P.P.Wegener.
J. chem. Phys., Vol. 28, No. 4, 724-5 (April, 1958).

Calculations for a dilute solution of N_2O_4 and NO_2 in N_2 which ndergoes an adiabatic expansion are described, and the concentra- ions were found to lie between the values for frozen and equilibrium states. The experimental scatter is too large to suggest a tempera- ure dependence. P.Gray

541.128

476. HALOGEN-CATALYZED DECOMPOSITION OF N_2O AND THE ROLE OF THE HYPOHALITE RADICAL. S.W.Benson and J.H.Buss.
J. chem. Phys., Vol. 27, No. 6, 1382-4 (Dec., 1957).

It is shown that the Cl_2 catalyzed decomposition of N_2O cannot be explained by a non-chain reaction but is consistent with a Cl atom chain in which Cl atoms are regenerated by the reactions,

$$2ClO \rightarrow Cl{-}O{-}O + Cl \qquad (1)$$

and by $ClO{-}N_2O \rightarrow N_2 + Cl{-}O{-}O$

followed by $Cl{-}O{-}O + M \rightarrow Cl + O_2 + M$

It is proposed that the peroxy radical Cl—O—O is the unstable inter- mediate responsible for the high efficiency observed for O_2 in cata- lyzing the recombination of Cl atoms. It is also proposed that at low temperatures O_2 should be an efficient catalyst for the generation of Cl atoms via the reaction $O_2 + Cl_2 \rightarrow O{-}O{-}Cl + Cl$. The peroxy ClOO species is shown to be a reasonable one to account for the high-rate constant observed for reaction (1) and for the chain decompositions of Cl_2O and OClO. Its thermodynamic properties are estimated as $\Delta H_f^0 = 21 \pm 2$ kcal, $S_f^0 = 61$ cal/mole deg K, with a bond-dissociation energy, D(Cl—OO) = 8 ± 2 kcal. A.

ELECTROCHEMISTRY

541.135.5 : 548.5

6477. ON THE NUCLEATION OF NEW CRYSTALS DURING ELECTRODEPOSITION. D.A.Vermilyea.
J. chem. Phys., Vol. 28, No. 4, 717 (April, 1958).

See Abstr. 3543 (1958). Deposits of copper produced at 15 mV (i.e. small overvoltage) on copper whiskers are polycrystalline while the whiskers themselves are single crystals. An explanation based on the view that the process of building adsorbed impurities into a crystal makes the nucleation of new crystals possible. W.Good

541.135.5

6478. KINETICS OF ELECTRODEPOSITION OF SILVER. P.B.Price and D.A.Vermilyea.
J. chem. Phys., Vol. 28, No. 4, 720-1 (April, 1958).

A new technique for the measurement of the rate constant for the electrodeposition is described in which the current passing during the steady growth of a silver whisker was suddenly lowered and the voltage across the electrolytic cell measured in 10^{-3} sec with an oscilloscope. The exchange currents, determined from plots of current density against voltage and measured for different metal ion concentrations were in the range 1-7 A/cm^2 and the average value obtained for the rate constant was 1.4×10^{-2} cm/sec. The large value of the latter makes it likely that deposition occurs directly at kinks on the surface. W.Good

541.138.2

6479. ON THE RELATION BETWEEN CURRENT AND FIELD DURING ANODIC OXIDATION. P.Winkel, C.A.Pistorius and W.C.van Geel.
Philips Res. Rep., Vol. 13, No. 3, 277-95 (June, 1958).

Starting from the assumption that an anodic oxide layer on metals like Al and Ta has an amorphous structure, a relation between field and current during anodic oxidation is derived. It appears that this relation is somewhat different from the exponential one usually derived in literature (Verwey, Mott). With these formulae, it is possible to explain the various results obtained with the experiments reported in this paper. Probably they may explain the rather different numerical results mentioned in literature in the same way. The consequences of the amorphous structure on a more detailed picture of the oxidation process, as proposed earlier were also calculated. The results point to a frequency dependence of one of the parameters as was actually observed in these experiments. The observed agreement between theory and experiments has made it possible to calculate approximately the parameters introduced in this theory. A.

PHOTOCHEMISTRY. RADIATION CHEMISTRY

541.14

6480. PHOTO-ORIENTATION. A.C.Albrecht.
J. chem. Phys., Vol. 27, No. 6, 1413-14 (Dec., 1957).

Shows theoretically that solute molecules in a rigid medium may be permanently oriented by absorption of light followed by degradation into heat of the electronic excitation, and by transient rotational diffusion. J.Hawgood

541.15

6481. ACCELERATION OF X-RAY ENERGIZED CHEMICAL REACTIONS OF ORGANIC GASES BY ENERGY TRANSFER FROM NOBLE GASES. R.C.Palmer, D.C.Bardwell and M.D.Peterson.
J. chem. Phys., Vol. 28, No. 1, 167 (Jan., 1958).

It was found that polymerization of acetylene by the action of 50 kVp X-rays is accelerated by a factor of about 30 per mm Hg addition of argon, and by about 5 per mm Hg addition of neon, whilst helium admixture gave no significant acceleration. J.R.Mallard

541.15

6482. RADIOLYSIS OF CF_4—C_6H_6 SYSTEMS.
P.Y.Feng and L.Mamula.
J. chem. Phys., Vol. 28, No. 3, 507-8 (March, 1958).

This leads to the products $C_6H_5CF_3$, C_6H_5F, CHF_3, and HF. Consideration of the yields (G values) leads to the conclusion that radical combination reactions cannot be involved. W.Good

541.15

6483. LOWER LIMIT TO THE RATE WITH WHICH OH RADICALS REACT WITH METHYLENE BLUE. D.A.Ross and F.Hutchinson.
J. chem. Phys., Vol. 28, No. 4, 745-6 (April, 1958).

The decolorization of methylene blue by irradiation with 1 MeV electrons was studied. A minimum value of 0.12 is given for the ratio of the actual reaction rate to the rate which would be found if a reaction occurred on every encounter between a radical and a methylene blue molecule. J.R.Mallard

541.15

6484. NITROGEN PENTOXIDE FORMATION BY IONIZING RADIATION. P.Harteck and S.Dondes.
J. chem. Phys., Vol. 28, No. 5, 975-6 (May, 1958).

In the early stages of high-intensity irradiation of nitrogen—oxygen mixtures, the pressure changes and the low yield of nitrous oxide can only be explained by the formation of nitrogen pentoxide. J.R.Mallard

541.15

6485. RADIATION CHEMISTRY OF CYCLOHEXANE.
A.C.Nixon and R.E.Thorpe.
J. chem. Phys., Vol. 28, No. 5, 1004-5 (May, 1958).

The liquid products resulting from the gamma irradiation of cyclohexane to 4.8×10^{21} eV/g were determined by means of gas-liquid chromatography and spectroscopy. The cyclohexyl ring is shown to be comparatively resistant to ring rupture, but extensive rearrangement to a five-membered ring system occurs. Neglecting gaseous products, 3.3% wt of the cyclohexane reacted. The major individual product is bicyclohexyl. J.R.Mallard

541.15

6486. PARAMAGNETIC SPECIES PRODUCED BY γ IRRADIATION OF ORGANIC COMPOUNDS. B.Smaller and M.S.Matheson.
J. chem. Phys., Vol. 28, No. 6, 1169-78 (June, 1958).

Some alkanes, olefins, alcohols, ethers, and a few other organic compounds were irradiated with Co^{60} γ-rays at low temperatures. The frozen irradiated samples were examined for paramagnetic resonance, and the observed spectra in several cases have been identified with specific radicals. The methyl, ethyl, and allyl radicals are among those identified. The results in each case are considered in relation to the present knowledge of the radiation chemistry of the compound. The mode of radical formation in many cases appears to be quite specific. Thus, in normal alkanes the major process for radical formation is by loss of a specific H atom. Hyperconjugation is used to interpret the resonance spectra. A.

DISPERSIONS. COLLOIDS. ADSORPTION

541.183

6487. ADSORPTION AND DIFFUSION OF OXYGEN ON TUNGSTEN. R.Gomer and J.K.Hulm.
J. chem. Phys., Vol. 27, No. 6, 1363-76 (Dec., 1957).

The surface diffusion and adsorption of oxygen on tungsten was studied by a field emission technique, by utilizing the high sticking coefficient, and negligible vapour pressure of O_2 at 4.2-20°K. Three types of migration were noted. At ~ 27°K diffusion occurs with a sharp boundary and an activation energy $E_d \cong 0.9$ kcal. This is believed to be migration of physically adsorbed O_2 over the chemisorbed layer, with precipitation on the bare surface. The distance traversed by the boundary was found to be limited by desorption above ~ 40°K. A study of this effect yielded as estimate of 2.3 kcal for the heat of adsorption, H_a, in the physisorbed layer. At 400-500°K and high coverages, diffusion occurs within the monolayer with activation energies of 23-25 kcal. Boundaries moving radially outward from the close-packed faces are observed, and believed to result from precipitation of O atoms in trap sites on the rough regions of the surface. At low coverages boundary free diffusion with $E_d \cong 30$ kcal is observed and interpreted as migration from trap sites. The latter are believed to constitute ~ 60% of all sites. Activation entropies for the various diffusion processes are estimated to vary from ~ 7-13 eu. It was found that 80% of the chemisorbed lay can be formed without appreciable activation at 27°K. The layer is stable up to 700°K, where desorption and oxidation start. The latte is markedly dependent on the amount of oxygen on the surface. At 300°K there is a slow oxygen uptake probably associated with incip ent oxidation.

541.18

6488. ON THE LOW-TEMPERATURE CHEMISORPTION OF N_2 AND CO. G.Ehrlich, T.W.Hickmott and F.G.Hudda.
J. chem. Phys., Vol. 28, No. 3, 506-7 (March, 1958).

The γ (i.e. the most weakly bound) state of N_2 on tungsten, is c the basis of electron-microscopic studies, believed to consist of a dipole layer with a moment directed away from the surface. CO o tungsten does not appear to give a γ state. S.J.Greg

541.183.

6489. ARGON ADSORBED ON A GRAPHITIC SURFACE. THE HEAT OF ADSORPTION FROM LATTICE LIQUID THEORY. E.L.Pace.
J. chem. Phys., Vol. 27, No. 6, 1341-6 (Dec., 1957).

A model is proposed to account for the differential or isosteri heat of adsorption which has been observed for argon on Graphon a concentrations between 0.5 and 2.0 monolayers for temperatures i the neighbourhood of the normal boiling point of argon. The energy of a molecule on the surface is considered to be the sum of two contributions: (1) a site energy for the isolated molecule and (2) a interaction energy with neighbours in the same layer. The site energy for a molecule is calculated assuming atoms and molecules in lower layers fixed with respect to both a configuration in a hexagonally packed planar lattice and the distance between layers. The interaction energy is calculated assuming the behaviour in any layer is represented by a two dimensional lattice liquid model utilizing the so-called Ono approximation for the variation of the generalized free volume with vacancies in the lattice. The distribution of adsorbed molecules in any layer is considered to be completely random. On the basis of this model, an interpretation is made of the two maxima in the isosteric heat which have been observed experimentally.

CHEMICAL STRUCTURE

541.6 : 532.73 : 539.

6490. IODINE COMPLEXES IN INERT SOLVENTS. V. EVIDENCE OF CONSECUTIVE MECHANISMS FOR THE REACTION BETWEEN IODINE AND ETHANOL OR METHANOL. P.A.D. de Maine.
J. chem. Phys., Vol. 28, No. 5, 1002-3 (May, 1958).

For Pt IV, see Abstr. 6676 (1957). The absorption spectrum indicates that the tri-iodide producing reaction can be reversed wi an increase in the concentration of the charge-transfer complex, t the charge-transfer band continues to decrease with time. This suggests that a consecutive mechanism producing HI_3 is involved. G.I.W.Llewel

CHEMICAL ANALYSIS

545

6491. A SIMPLE, AUTOMATIC, HIGH-TEMPERATURE THERMAL ANALYSIS APPARATUS. S.J.Lloyd and J.R.Murray.
J. sci. Instrum., Vol. 35, No. 7, 252-4 (July, 1958).

The sample, in a chamber which may be evacuated to better t 10^{-5} mm Hg at 1000°C, is heated by a molybdenum element and th thermal arrests are indicated by the differential method. By plac the sample in direct contact with the thermocouple hot-junction, s state phase-changes may be detected in samples as small as 0.3 g Alternatively, samples of 20-80 g may be contained in crucibles a using the arrangement, thermal arrests have been detected at tem atures up to 1550°C.

545.

6492. SQUARE WAVE POLAROGRAPHY. II. NOTES ON THE USE OF THE SQUARE WAVE POLAROGRAPH.
G.C.Barker and D.R.Cockbaine.
Atomic Energy Res. Establ. (Harwell), Rep. C/R1404, 23 pp. (195

545.37

493. SQUARE WAVE POLAROGRAPHY. III. SINGLE DROP OLAROGRAPHY. G.C.Barker.
tomic Energy Res. Establ. (Harwell), Rep. C/R1563, 10 pp. (1957).

A method is described for the detection and determination, at oncentrations below 10^{-7} M, of ions of some of the metals which are oluble in mercury. A single mercury drop is used as an electrode nd before recording a polarogram the ions in question are concen- ated in the drop. A.

545.822

494. SPECTRAL ANALYSIS OF SMALL SAMPLES OF CTINIUM. N.I.Kaliteevskii and A.N.Razumovskii.
tomnaya Energiya, Vol. 3, No. 12, 548-50 (1957). In Russian.

The spectrum of several samples, weighing a few micrograms, as excited in an enclosed chamber by a spark or controlled arc. table of 54 lines, measured to 0.1 A, is given, together with a short iscussion on spectral examination for impurities. L.Bovey

545.823

6495. SENSITIVE DETECTION OF LEAD AND THE INCORPORATION OF LEAD IN ZINC SULPHIDE.
E.A.Schwager and A.Fischer.
Z. Phys., Vol. 149, No. 3, 347-52 (1957). In German.

Lead can be detected to 5×10^{-6} g of Pb per ml. of solution by its characteristic luminescence in ZnS. In the presence of S vacancies, lead enters the ZnS lattice, giving a green emission; electrophotoluminescence occurs under u.v. With excess S, mixed crystals of ZnS—PbS are formed, and a yellow emission is obtained which shifts to the red at low temperatures. J.Franks

545.844

6496. A COMPACT AND VERSATILE FRACTION COLLECTOR.
A.Snow, F.A.E.Porter and A.W.Tomalin.
J. sci. Instrum., Vol. 35, No. 7, 243-4 (July, 1958).

The tubes are arranged spirally to conserve space, but each tube is brought in turn directly under the column in order to avoid mixing of successive drops in any connecting tube. The turn-table movement can be initiated without difficulty by most devices used for determining sample size. The turn-table itself is easily replaceable and can be removed and used for storage. A.

CRYSTALLOGRAPHY

548.1 : 621-229

6497. JIGS FOR MAKING CRYSTALLOGRAPHIC WIRE MODELS.
W.Hughes and C.A.Taylor.
J. sci. Instrum., Vol. 35, No. 7, 261-4 (July, 1958).

Models made from stiff wire, in which the bends, junctions and free ends represent atomic centres, are often used in structure-determination and other crystallographic problems, but are not easy to make accurately. Two jigs are described, one for making successive bends in a single piece of wire, the other for clamping wires in the correct relative orientations while soldering. They permit models to be made rapidly by a comparatively unskilled operator. A.

548.5

6498. EXPERIMENTAL STUDIES ON GRAIN GROWTH IN METALS. H.U.Åström.
Ark. Fys., Vol. 13, Paper 5, 69-80 (1957).

A combination of calorimetric and microscopic methods has made it possible to determine the average specific energy of the large-angle boundaries in some pure metals. The values obtained are for Ag 790 erg/cm^2, Al 630 erg/cm^2 and Zn 1740 erg/cm^2 within an accuracy of some 20%. These measurements give, however, the total energies while the results obtained earlier with the dihedral angle method are free energies. After subtracting a reasonable entropy term the results of the two methods seem to be quite comparable in magnitude for silver. The extremely high energy of zinc is thought to be due to the anisotropy of the hexagonal metals which may influence the structure of the large-angle boundaries. The energy of activation for grain-growth was calculated from the microscopically determined rate of change of the boundary area for a fixed grain size at different temperatures. The following energies were obtained: Cu 55 000, Au 49 000, Ag 57 000, Al 62 000, and Zn 150 000 cal/mole. It is concluded that these values are strictly valid only at the temperatures of the determination and for the purity of the metals used, because of a probable temperature and concentration dependence of the interaction between the impurities and the grain boundaries. A.

548.5

6499. GROWTH SPIRALS ON ELECTRODEPOSITED SILVER.
V.G.Bhide and W.G.Nafde.
Curr. Sci., Vol. 27, No. 5, 167 (May, 1958).

Reports briefly that triangular, hexagonal and circular growth spirals were sometimes observed on the (111) faces of crystals of silver grown by electrolysing an aqueous solution of $AgNO_3$. S.Weintroub

548.5 : 548.74

6500. GROWTH OF OXIDE WHISKERS ON METALS AT HIGH TEMPERATURE. R.Takagi.
J. Phys. Soc. Japan, Vol. 12, No. 11, 1212-18 (Nov., 1957).

The growth of α-Fe_2O_3 whiskers formed on pure iron in oxygen at 400°-850°C was studied by electron microscopy and diffraction using specimens taken successively from a uniformly oxidized wire which was heated consecutively to avoid the effects of contaminants condensed during electron-microscopic observation. A whisker grows at the tip by surface diffusion of molecules from base to tip. Axial growth at a fixed temperature is approximately given by: $l = kt^{0.3}$, where k, a constant, depends on temperature and has a maximum at 700° ~ 750°C. Initial diameter corresponds to that which gives the minimum strength necessary to keep whisker shape at the growth temperature. A whisker has an axis parallel to $< 110 >_{hex}$, becoming thereafter a blade-shaped crystal parallel to (001). Further growth at the tip of a blade-shaped crystal occurs at those sites which are in a plane parallel to (001), and similar growth occurs also on a fracture surface of a mechanically truncated crystal. A.

548.5 : 539.2

6501. MACROSCOPIC THEORY OF FORMATION OF DISLOCATIONS DURING CRYSTAL GROWTH. V.L.Indenbom.
Kristallografiya, Vol. 2, No. 5, 594-603 (1957). In Russian.

A theory is proposed, applicable to zone purification, hardening, cooling after annealing, and in particular to crystal growth, according to which dislocations arise as a result of non-uniform temperature distribution. The macroscopic density of dislocations is given by the tensor $\beta = -\text{grad } T \times \alpha$, where T is the temperature and α is the thermal expansion tensor. In a simple cubic lattice, the diagonal components of β correspond to the density of screw dislocations, and the off-diagonal components to the density of edge dislocations. R.F.S.Hearmon

548.5 : 539.373

ON THE OCCURRENCE OF SLIP IN DIAMOND. See Abstr. 6450

548.52 : 548.54

6502. THE GROWTH OF ICE CRYSTALS FROM THE VAPOUR AND THE MELT. B.J.Mason.
Advances in Phys., Vol. 7, 235-53 (April, 1958).

A review of recent studies of the relationship between the shape, structure and growth rate of the crystals to environmental conditions. In Part 1, dealing with growth from the vapour, the occurrence and habits of ice crystals in natural clouds, laboratory-produced crystals, measurements of the growth rates, the transition from polyhedral to dendritic growth, influence of aerosols and foreign vapours on the habit, and the epitaxy of ice on foreign substrates are individually considered. It is stated that at present there is no convincing explanation for the observed variations of ice-crystal habit with temperature, but they may be associated with changes in the surface structure and properties of the crystal. The detailed mechanism of ice-crystal growth requires much addit-

ional experiment. The various methods for the production of large single crystals from the melt are described in Part 2, together with a summary of the observations, (mainly by Arakawa and other Japanese workers), of the stages in the formation of ice crystals on the surface of slightly supercooled water. S.Weintroub

548.54

6503. THE EQUILIBRIUM FORM OF CRYSTALS IN THE GRAVITATIONAL FORCE FIELD. A.V.Belyustin.
Kristallografiya, Vol. 2, No. 5, 590-3 (1957). In Russian.

Using the condition that the sum of the surface and potential energies is a minimum, formulae are obtained connecting the height of certain crystals with their width. The effect of fluctuations in temperature is also considered. R.F.S.Hearmon

548.574

6504. CORRELATION OF THERMAL ETCH PITS WITH DISLOCATIONS IN SILVER. J.P.Hirth and L.Vassamillet.
J. appl. Phys., Vol. 29, No. 3, 595 (March, 1958).

Thermal-etch-pit counts on silver crystals give densities of $2 \times 10^6/cm^2$ on {100} and {111} surfaces and $10^6/cm^2$ on {110} surfaces. On low index surfaces smaller etch pits with high density were seen within macroscopic pits of density $2 \times 10^6/cm^2$. A modified double-crystal spectrometer technique, used to check dislocation densities, showed density intersecting these surfaces of order 10^8 cm/cm^3, assuming isotropic distribution of dislocations. It is concluded that there is not a direct correlation between thermal etch pits and dislocations in silver. A possible explanation is that the formation of a pit at a dislocation is a function of the Burgers vector component normal to the surface. J.W.Menter

548.574

6505. SPIRAL ETCH-PITS IN GERMANIUM.
R.G.Rhodes, K.O.Batsford and D.J.Dane-Thomas.
J. Electronics and Control, Vol. 3, No. 4, 403-8 (Oct., 1957).

Details are given both of the etching technique, which includes an iodine etchant, and the randomly distributed spiral pits of average density 10^5-10^6 cm^{-2} that are revealed on both the {111} and {100} crystal surfaces of germanium single crystals, grown by either the Czochralski "pulling" method or by horizontal zone-melting. Photomicrographs of the characteristic pits on the {100} surfaces are shown. The pits were 5-50 μ across and approximately 2 μ deep. Both right- and left-handed spiral terraces, with a few double spirals, were present and they consisted of up to ten turns of step-heights of the order of 2000 A. A plot of the measured electrical resistivity of the crystals as a function of the density of the pits lends support to the possibility that the pits are related to the presence of impurities in the crystals. S.Weintroub

548.574

6506. SPIRAL ETCH-PITS IN GERMANIUM. G.Elliott.
J. Electronics and Control, Vol. 4, No. 5, 456-7 (May, 1958).

Reports briefly on observations made on germanium single crystals of [100] orientation using a similar etchant to that of Rhodes and co-workers (see preceding abstract). A seed crystal, of resistivity about 40 ohm cm, but with an etch-pit count of 1.2×10^6, gave rise to crystals with polygonized structures, which suggests a connection between the pits and structural imperfections in the crystal. S.Weintroub

548.574 : 537.534.9

6507. FORMATION OF ORIENTED FIGURES BY IONIC BOMBARDMENT OF METALS. V.E.Yurasova.
Kristallografiya, Vol. 2, No. 6, 770-5 (1957). In Russian.

The conditions for obtaining clear figures are established, and examples quoted for Al, Bi, Cd, Co, Mg, Cu, Sn and Zn. Photographs are reproduced of Al, Cd and Bi surfaces after bombardment with neon ions. The possibility of using the method to detect slip planes in metallic single crystals is discussed. See also Abstr. 213/1958. R.F.S.Hearmon

X-RAY CRYSTALLOGRAPHY

548.73/.74

6508. SOME NEW X-RAY AND NEUTRON STUDIES OF HYDROGEN BONDING. R.Pepinsky.
Rev. mod. Phys., Vol. 30, No. 1, 100 (Jan., 1958).

Discusses the results obtained at or in collaboration with Pennsylvania State University, in which 3-dimensional Fourier syntheses have been used in some instances. Among the techniques employed is that of isomorphous hydrogen—deuterium replacement. The existence of "bifurated" H bonds (hydrogens shared by three atoms) has been shown in cycloserine hydrochloride and very short intermolecular distances appear in the structure of cyclotetramethylene tetranitramine in which hydrogens are not involved. J.Thewlis

548.73/.74

X-RAY AND ELECTRON INVESTIGATION OF MATERIALS.
See also under "Structure of solids". Decimal classification 539.26/.27

548.73

6509. ON THE CORRECTIONS OF THE MEASURED INTEGRATE BRAGG REFLECTIONS DUE TO THERMAL DIFFUSE SCATTERING. N.Nilsson.
Ark. Fys., Vol. 12, Paper 6, 247-57 (1957).

The contribution of the diffuse scattering to the measured intensity of a Bragg reflection was computed for some reflections o sylvite and rock-salt, assuming width of slits and angles of rotation corresponding to the experiments made by James and Brindley (Abstr. 844/1929) and Renninger (Abstr. 7323/1953). It is evident that the contribution of the diffuse scattering to the measured integrated reflections amounts to considerable values (up to 30% for the highest reflections), and thus cannot be neglected as has been though until now. The measured integrated reflection can, in respect of the dependence of the Bragg angle ν_0, be written as the real integrated Bragg reflection times a factor $\exp[\text{const}(\sin^2\nu_0/\lambda^2)]$, due to the effe of the diffuse scattering. This fact explains why good agreement ca be obtained between theoretically calculated F-values and those obtained from intensity measurements and experimentally determined Debye—Waller factors. A.

548.73

6510. LOW-ANGLE X-RAY SCATTERING FROM COLD-WORKEI METALS. A.Franks and K.Thomas.
Proc. Phys. Soc., Vol. 71, Pt 5, 861-2 (May, 1958).

Experiments on variation of low-angle scattering with wavelength tend to confirm the suggestion that scattering at low angles is due to double Bragg reflection by sub-crystals with a small range o misorientation (cf Atkinson, Abstr. 4487/1958). A.R.Stokes

548.73

6511. OPTICAL DIFFRACTOMETER FOR FACILITATION OF X-RAY DIFFRACTION STUDIES OF MACROMOLECULAR STRUCTURES. H.W.Wyckoff, R.S.Bear, R.S.Morgan and D.Carlstrom.
J. Opt. Soc. Amer., Vol. 47, No. 12, 1061-9 (Dec., 1957).

An instrument employing optical analogies to the diffraction of X-rays by macromolecular substances is described. Simple and readily obtainable components, materials and procedures are involved. Photographic methods are used to reduce the size of model for trial structures in forming masks whose optical diffraction is then compared with the X-ray diffraction of real structures. Conversely, the diffractometer can be employed to synthesize images o structures from masks simulating observed X-ray diffraction. Applications are described dealing with the investigation of helical chain molecules (polypeptide α-helices, collagen and deoxyribonucleate molecules); with the study of larger sized structures exhibiting small-angle X-ray diffraction (e.g., collagen fibrils); and with imag synthesis for centrosymmetric configurations (phthalocyanine). A.

548.734.

6512. X-RAY SETTING OF SINGLE CRYSTALS IN A CYLINDRICAL CHAMBER GONIOMETER.
R.Zannetti and P.Bellon.
Ricerca sci., Vol. 27, No. 7, 2183-6 (July, 1957). In Italian.

The method is for the case where the zero-layer reflections are insufficient for precise calculation of the errors on the goniometer's two head arcs, but where higher-order reflections are available. A

548.73

6513. POSSIBLE EXPLANATION FOR MOSAIC-LIKE BRAGG REFLECTION IN QUARTZ UNDER STRAIN. D.W.Berreman.
Phys. Rev., Vol. 110, No. 4, 992-3 (May 15, 1958).

Mosaic-like reflection is attributed to slight curvature of reflecting planes of atoms. Calculations show the radii of curvature

the order of 10-100 m) required to account for observed haviour. A.R.Stokes

548.735.7 : 548.24

14. CRYSTALLITES AND TWINNING IN COLD-ROLLED CKEL. A.P.Young.
appl. Phys., Vol. 29, No. 7, 1127 (July, 1958).
An electron micrograph shows crystallite sizes from 0.1 to 8 μ, and systems of bands indicating deformation twinning.
A.R.Stokes

548.736.1

15. X-RAY STUDY OF LABORATORY-MADE DIAMONDS. J.Grenville-Wells and K.Lonsdale.
ature (London), Vol. 181, 758-9 (March 15, 1958).
Rotation photographs show "forbidden" 200 and 420 reflections d satellites to all other reflections. These satellites, together th spectroscopic evidence for the presence of nickel, suggest the istence of nickel-carbide "islands", but the 200 and 420 reflections e not explained. It is suggested that a possible intermediate rbon structure in the graphite → diamond transformation would also ve these satellite spots. A.R.Stokes

548.736.1

516. STRUCTURE OF THE α AND β FORMS OF SOLID He^3. F.Schuch, E.R.Grilly and R.L.Mills.
ys. Rev., Vol. 110, No. 3, 775 (May 1, 1958).
The two forms exist respectively below and above a line on the mperature–pressure diagram that meets the melting curve at 15°K and 141 kg cm^{-2}. The α form is body-centred cubic and the form is hexagonal close-packed. A.R.Stokes

548.736.1 : 535.515

LATTICE STRUCTURE OF SOLID HELIUM. See Abstr. 5818

548.736.4 : 538.221

CRYSTALLOGRAPHIC AND MAGNETOCHEMICAL STUDIES N ABO_3 GROUP COMPOUNDS OF LANTHANON AND MANGANESE XIDES. See Abstr. 6037

548.736.5

517. STRUCTURE OF ROUSSIN'S BLACK SALT. G.Johansson and W.N.Lipscomb.
. chem. Phys., Vol. 27, No. 6, 1417 (Dec., 1957).
$CsFe_4S_3(NO)_7.H_2O$ is triclinic, space-group $P\bar{1}$. Lattice parameters, atomic positions, and a summary description of the structure are given. A.R.Stokes

548.74

518. THE MICROSTRUCTURE OF PHOTOCONDUCTING PbTe LAYERS. A.Feltynowski, I.Glass and L.Grelewicz.
Exper. Tech. der Phys., Vol. 6, No. 1, 17-20 (1958). In German.
Electron diffraction by thin films of PbTe indicates the existence of a simple cubic structure with a = 3.21 A, with Pb and Te atoms randomly arranged (cf. NaCl-type structure with a = 6.34 A found by X-ray diffraction). A.R.Stokes

548.74 : 548.736.3

6519. THE STRUCTURE OF ICE-I, AS DETERMINED BY X-RAY AND NEUTRON DIFFRACTION ANALYSIS. P.G.Owston.
Advances in Phys., Vol. 7, 171-88 (April, 1958).
The various structures, including in particular Barnes', Bernal and Fowler's and the statistical structures, which have been proposed for ice, together with the evidence for them are summarized. The results of investigations of the locations of the hydrogen atoms by X-ray and neutron diffraction are given special attention.
(See also Abstr. 5731, 6320/1958). S.Weintroub

548.74

6520. ELECTRON DIFFRACTION INVESTIGATIONS INTO THE CUBIC AND OTHER STRUCTURAL FORMS OF ICE.
M.Blackman and N.D.Lisgarten.
Advances in Phys., Vol. 7, 189-98 (April, 1958).
The experimental arrangements of the various investigations which have been made of the structure of ice by electron diffraction are briefly outlined and the results obtained are discussed. For deposits formed at low temperatures it is agreed that three types of diffraction patterns occur, but there are considerable discrepancies in the details of the results. Measurements of the hydrogen positions in cubic ice and of the lattice constants of cubic and hexagonal forms of both normal and heavy ice are discussed. The data suggest that the a and c values obtained by electron diffraction are about 0.4% lower than the X-ray values; c/a decreases with temperature; and the constants are substantially the same for both normal and heavy ice. Finally, the properties of deposits formed from water vapour at low temperatures obtained by electron diffraction, X-ray and calorimetric studies are summarized. S.Weintroub

548.74 : 539.2 : 538.114

CRITICAL MAGNETIC SCATTERING OF NEUTRONS IN FERROMAGNETS. See Abstr. 6028-30

548.74

6521. A TWO-CRYSTAL NEUTRON SPECTROMETER. V.N.Bŷkov, S.I.Vinogradov, V.A.Levdik and V.S.Golovkin.
Kristallografiya, Vol. 2, No. 5, 634-8 (1957). In Russian.
A description is given of a two-crystal spectrometer suitable for use with mono- and polycrystalline specimens. R.F.S.Hearmon

548.74 : 548.733

6522. SINGLE CRYSTAL GONIOMETER FOR X-RAY AND NEUTRON DIFFRACTION. G.E.B.Barstad and A.F.Andresen.
Rev. sci. Instrum., Vol. 28, No. 11, 916-18 (Nov., 1957).
A single crystal goniometer intended both for X-ray and neutron diffraction analysis has been used in neutron diffraction work at the Kjeller reactor. The unique feature of this goniometer is a macromodel of the unit cell designed for easy orienting of the crystal. A special arrangement is provided for setting any plane in reflecting position without previously calculating the angles, and a set of three-dimensional data can be recorded on a counter moving in the horizontal plane. A.

GEOPHYSICS

550.383

523. THE EARTH'S MAGNETIC FIELD ABOVE WSPG, NEW MEXICO, FROM ROCKET MEASUREMENTS.
I.P.Heppner, J.D.Stolarik and L.H.Meredith.
J. geophys. Res., Vol. 63, No. 2, 277-88 (June, 1958).
The absolute magnetic field was measured from ground level to an altitude of 163 km in this first rocket flight of a proton precessional magnetometer. The change in field with altitude differs significantly from that of a dipole. The field was typically quiet at firing time and an ionospheric discontinuity was not detected. A.

550.385

6524. THE PHYSICAL NATURE OF THE DIFFERENCES BETWEEN GEOMAGNETIC DISTURBANCES WITH SUDDEN AND NON-SUDDEN COMMENCEMENT. É.R.Mustel'.
Astron. Zh., Vol. 34, No. 1, 120-6 (1957). In Russian.

During strong chromospheric flares, which appear to cause SC-disturbances, a flow of a disturbing agent takes place in the outward direction. Radio emission studies show that the atoms of which these streams are probably composed have a complex velocity spectrum. It is argued that the ejection of these atoms is not due to radiation pressure but to a "specific complex non-stationary electromagnetic process". This process may not always be accompanied by bright flares, and the ejection of atoms may take place without such flares, and vice versa. The identical character of strong and weak SC-disturbances shows that in all cases of ejected particles one deals with the same non-stationary electromagnetic process as when flares are present. It follows that the areas at which these non-stationary phenomena occur, together with an increase in radio emission and a shift of the level of this emission in the corona, should be sources of particles which cause SC-disturbances. These areas should have an unstable character and be connected with sun-spots. Non-SC-disturbances are caused by flocculi. S.Chomet

550.385

6525. SOME COMMENTS ON J.S.CHATTERJEES'S "INDUCTION IN THE CORE BY MAGNETIC STORMS AND EARTH'S MAGNETISM". T.Rikitake.
J. geophys. Res., Vol. 62, No. 3, 493-4 (Sept., 1957).

It is shown that the time period required by Chatterjee's process (Abstr. 7860/1956) is too long for the process to be possible, and also would not account for the secular variation and supposed reversal of the earth's polarity. J.M.Hough

550.385

6526. ON THE GEOMAGNETIC STORM EFFECT. E.N.Parker.
J. geophys. Res., Vol. 61, No. 4, 625-37 (Dec., 1956).

The high electrical conductivity of the region surrounding earth, inferred from the observations of atmospheric whistlers and the zodiacal light, requires the abandoning of the customary models for producing a geomagnetic storm field with impressed current system. It becomes necessary to adopt a purely hydromagnetic approach wherein attention is focused only on the magnetic lines of force of the geomagnetic field and their displacement with the conducting gas surrounding earth. From the hydromagnetic point of view, a decrease of the horizontal component is brought about by lifting the lines of force in the region above the observer. It is suggested that heating in the upper atmosphere may produce the necessary lifting; this model, along with another, is developed quantitatively to show that lifting the lines of force a distance of only 5 km will produce a decrease in the horizontal component of 0.2% at the equator.

A.

550.385

6527. THE PROPAGATION VELOCITY OF WORLD-WIDE SUDDEN COMMENCEMENTS OF MAGNETIC STORMS.
A.J.Dessler.
J. geophys. Res., Vol. 63, No. 2, 405-8 (June, 1958).

The following model is presented for the propagation of a world-wide sudden-commencement of a magnetic storm. A longitudinal hydromagnetic wave will be generated by the impact between a plasma cloud ejected from the sun and the earth's magnetic field. This wave will travel from the point of impact both east and west around the geomagnetic equator and carry the magnetic effect of the impact to the back side of the earth. It is shown that this hydromagnetic wave will be stable at an altitude of about 400 km and travel with a velocity of about 130 km/sec. Thus, it is proposed that sudden commencements do not occur simultaneously over the earth. Rather, about 2 min are required for a sudden commencement to be propagated around the world. A.

550.385 : 551.594.5

MAGNETIC STORM THEORY. See Abstr. 5554

551.16

6528. THE FIGURE OF THE EARTH'S CORE AND THE NON-DIPOLE FIELD. G.D.Garland.
J. geophys. Res., Vol. 62, No. 3, 486-7 (Sept., 1957).

Longitude terms in the external gravitational field and the non-dipole magnetic field lead to a consideration of the possibility of a warping of the core boundary. It is suggested that this warping might be just detectable by seismic means. J.M.Hough

551.24

6529. ROCK CREEP AND THERMAL INSTABILITY. H.Jeffreys.
Geophys. J., Vol. 1, No. 2, 162-3 (June, 1958).

The theory of instability of a fluid heated below can be adapted without difficulty to a rock satisfying the modified Lonnitz law of creep. It is found that instability is impossible and therefore that steady convection currents would not arise. A.

ATMOSPHERE. METEOROLOGY

551.508.21

6530. ON THE ÅNGSTRÖM ABSOLUTE PYRHELIOMETRIC SCALE. F.Lindholm.
Tellus, Vol. 10, No. 2, 249-55 (May, 1958).

A critical examination of the original Ångström pyrheliometric scale was made from the result of recent calibration of the new modified Ångström pyrheliometer using the sun as radiation source. The mean marginal error of the old standard pyrheliometer was found to be +2.4%. The influence of the small difference in aperture of the two models was estimated to increase the correction insignificantly. This result means that the original scale-values with 2.4% added are given on the true energy scale. The corrected values are nearly 1% higher than on the pyrheliometric scale recommended by the Radiation Conference at Davos 1956. A practical pyrheliometric standard scale is a question of specification of the aperture conditions or of the amount of circumsolar sky radiation to be allowed in the standard pyrheliometer. A proposal of such a specification was given and recommended by the Conference at Davos. A.

551.508.71 : 533.275

NEW ABSOLUTE METHOD OF HYGROMETRY USING IONIC SINGLE CRYSTAL. See Abstr. 5706-7

551.510.52

6531. RELATION OF RADIO MEASUREMENTS TO THE SPECTRUM OF TROPOSPHERIC DIELECTRIC FLUCTUATIONS.
A.D.Wheelon.
J. appl. Phys., Vol. 28, No. 6, 684-93 (June, 1957).

The size spectrum of isotropic fluctuations in the troposphere's dielectric constant is related to quantities measured by radio means Two classes of experiments are analysed: (1) line-of-sight phase and amplitude instability and (2) refractometer measurements of dielectric fluctuations. This analysis is independent of models for the dielectric fluctuations and provides a system from which the spectrum can be estimated from experimental data. The measured quantities are expressed as weighted integrals of the spectrum, many of which may be inverted to give the spectrum directly in term of the data. Aerial smoothing by the receivers and finite data sample effects are studied, in addition to the basic propagation mechanisms. A.

551.510.53

6532. THE PROBLEM OF MEASURING PRESSURE AND DENSITY OF THE UPPER LAYERS OF THE ATMOSPHERE USING AN ARTIFICIAL EARTH SATELLITE.
B.S.Danilin, V.V.Mikhnevich, A.I.Repnev and E.G.Shvidkovskii.
Uspekhi fiz. Nauk, Vol. 63, No. 1b, 205-25 (1957). In Russian.

The physical aspects of measuring pressure and density, in the upper layers of the atmosphere are considered. It is assumed that the manometer employed will also measure ionization, as well as pressure and density, and is to be carried by an artificial earth satellite. 34 references. C.R.S.Manders

551.510.535

6533. A FURTHER NOTE ON IONOSPHERIC RECORDERS AND SPORADIC E. J.A.Thomas, H.E.Brown and G.G.Cairns.
Austral. J. Phys., Vol. 10, No. 2, 310-11 (June, 1957).

The effect of variation of transmitter power on P'f records was studied by recording alternately on high and low power. It was found that foEs and fbEs for the two major types of Es present at Brisbane were almost independent of transmitter power, suggesting that these parameters are true penetration frequencies.

G.M.Brown

551.510.535

6534. LATITUDE VARIATIONS OF FREQUENCY OF OCCURRENCE OF "SPREAD-F" SATELLITE TRACES.
R.W.E.McNicol and G.G.Bowman.
Austral. J. Phys., Vol. 10, No. 4, 588-90 (Dec., 1957).

Counts of the percentage number of ionograms at different stations which showed the phenomenon of "spread-F satellite traces" (Abstr. 7080/1956) show that this percentage varies fairly smoothly with geomagnetic latitude, but not with geographic latitude. The relative frequency of occurrence of satellite F traces appears to be a maximum in the range from 20° to 45° geomagnetic latitude.

G.M.Brown

551.510.535 : 550.385

6535. VARIATIONS IN THE HEIGHT OF IONOSPHERIC LAYERS DURING MAGNETIC STORMS. E.Tandberg-Hanssen.
J. geophys. Res., Vol. 63, No. 1, 157-60 (March, 1958).

The variations of the virtual heights of the F1 and E layers of the ionosphere are studied and it is found that, in general, the E layer remains unchanged, while the F1 layer rises during geomagnetic storms. This is applied to Parker's theory for magnetic storms (see Abstr. 6526/1958), and it is concluded that the absorption of the storm-associated solar energy takes place at a height between 100 and 200 km. A.

551.510.535

536. IONOSPHERE ELECTRON-DENSITY MEASUREMENTS TTH THE NAVY AEROBEE-HI ROCKET.
.E.Jackson and J.C.Seddon.
geophys. Res., Vol. 63, No. 1, 197-208 (March, 1958).

The electron densities were measured continuously from the region up to the lower F2 region. The results confirm the eneral structure of the daytime ionosphere above White Sands N.Mexico) as deduced from previous rocket flights, namely, that ie ionosphere remains dense between the E and F2 regions, with nly minor valleys in the electron-density profiles. The electron-ensity distribution is shown to be consistent with the P'-f records btained during the rocket flight. The sporadic-E condition, seen n these ionograms, was found to be associated with a sharp spike n the electron-density profile at an altitude of 101 km and approxi-nately 1 km thick . This sporadic condition extended over a orizontal distance of at least 80 km. A.

551.510.535

537. MEDIUM-FREQUENCY OBSERVATIONS OF THE LOWER ONOSPHERE DURING SUDDEN DISTURBANCES. J.B.Gregory.
. geophys. Res., Vol. 63, No. 1, 273-5 (March, 1958).

Over 40 sudden ionospheric disturbances were recorded on a .75 Mc/s pulse-sounding apparatus. The results emphasize the rgument of Friedman and Chubb (Abstr. 5766/1955) that their cause s not ionization produced by Lyman-α, but is more likely produced y soft X-rays. J.M.Hough

551.510.535 : 551.594.5

538. THE ROLE OF F-LAYER TILTS IN DETECTION OF URORAL IONIZATION. S.Stein.
. geophys. Res., Vol. 63, No. 2, 391-404 (June, 1958).

An important ionospheric mode for detection of powerful long-ange auroral reflections at Stanford depends upon appropriate tilts n the F layer to the north. Auroral reflections received via this node were reported as originating from prevalent, strongly reflecting onized structures at great heights, between 300 km and 1200 km bove the surface of the earth. This interpretation is rejected as a lausible explanation of the radio data. An explicit distinction is nade between these auroral reflections and newer classes of radio eflections observed at high and middle latitudes arising from field-ligned ionization in the E and F regions. A.

551.510.535

539. IONOSPHERIC PARAMETERS DEDUCED FROM THE FARADAY ROTATION OF LUNAR RADIO REFLECTIONS.
.J.Bauer and F.B.Daniels.
J. geophys. Res., Vol. 63, No. 2, 439-42 (June, 1958).

Waves of 150 Mc/s were transmitted from Belmar, New Jersey, nd received at Urbana, Illinois, and enabled the ratio of the number of electrons above the maximum to those below to be calculated as 3.4, with the use of data on the ionosphere according to a parabolic-ayer model. J.M.Hough

551.510.535

6540. FIELD-STRENGTH VARIATIONS RECORDED ON A V.H.F. IONOSPHERIC SCATTER CIRCUIT DURING THE SOLAR EVENT OF FEBRUARY 23, 1956. H.I.Leighton.
J. geophys. Res., Vol. 62, No. 3, 483-4 (Sept., 1957).

An enhancement is reported of the 50 Mc/s signal on an ionospheric scatter circuit during the night when a solar flare was in progress, as reported from the other side of the earth.

J.M.Hough

551.510.535

6541. COMPLETE NIGHT OF VERTICAL-INCIDENCE IONOSPHERE SOUNDINGS COVERING FREQUENCY RANGE FROM 50 kc/s TO 25 Mc/s. J.M.Watts.
J. geophys. Res., Vol. 62, No. 3, 484-5 (Sept., 1957).

Presents a half-hourly series of photographs of soundings on a linear scale from 50 kc/s to 2 Mc/s, and on a logarithmic scale above 2 Mc/s, for a quiet night. Illustrates the data missed if only high-frequency recorders are used. J.M.Hough

551.510.535

6542. HORIZONTAL IONOSPHERIC DRIFTS IN THE F2-REGION AT EQUATORIAL LATITUDES.
B.Ramachandra Rao and E.Bhagiratha Rao.
Nature (London), Vol. 181, 1612-13 (June 7, 1958).

Measurements using the spaced-receiver method at Waltair (17°43'N) have shown that both the N—S and E—W components have a predominant 24 hr period, with a net direction which changes in a clockwise sense. The direction of drift is opposite to that observed at higher latitudes, in agreement with Martyn's theory.

G.M.Brown

551.510.535

RADIO-WAVE PROPAGATION IN THE IONOSPHERE. See also under "Electromagnetic waves and oscillations". Decimal classification 538.566.3

551.521.3 : 535.436

6543. TRANSPORT CALCULATION OF THE NET CURRENT OF PHOTONS IN AN ISOTROPICALLY-SCATTERING ATMOSPHERE.
J.F.Batter, Jr.
J. Opt. Soc. Amer., Vol. 48, No. 6, 371-4 (June, 1958).

The net photon current is obtained from the exact transport solution for photon density in an infinite isotropic atmosphere. An analytical-numerical solution for the photon current is developed and presented graphically together with the diffusion theory current versus nondimensional distance. A.

551.521.3

6544. DIFFUSE TRANSMISSION THROUGH REAL ATMOSPHERES.
R.G.Eldridge and J.C.Johnson.
J. Opt. Soc. Amer., Vol. 48, No. 7, 463-8 (July, 1958).

Diffuse transmission through atmospheres of haze and clouds were measured over slant ranges from 0.5 to 9.0 kilometres. The modification of the transmissions when the source was near a diffusely reflecting surface was also measured. The transmissions are presented as curves representing the least squares fit to the experimental data for general weather conditions. A.

551.521.3

6545. A DEVICE FOR VISUALIZING THE PATTERN OF PLANE POLARIZED LIGHT FROM BLUE SKY. J.A.Chapman.
Nature (London), Vol. 181, 1393-4 (May 17, 1958).

To enable the human eye to "see" the polarization pattern present in a small angular area of day sky, and to detect differences in the percentage polarization of the skylight received from different directions, the sky is viewed through a rotating radial slit covered by a "Polaroid" filter. With the polarizing axis of the filter set perpendicular to the slit, darker zones in the visual field define the plane of polarization of the skylight. D.R.Barber

551.521.326

6546. A NEW DETERMINATION OF THE ALTITUDE OF EMISSION OF THE GREEN LINE OF THE NIGHT-SKY LIGHT BY VAN RHIJN'S METHOD. D.Barbier and J.Glaume.
Ann. Géophys., Vol. 13, No. 4, 317-20 (1957). In French.

Taking account of known sources of error, a new experimental evaluation of the height of emission of the 5577 A night-glow gives a mean altitude around 100 km. This result contradicts the previously-determined value of ~ 300 km (Abstr. 2303/1952), but it agrees with that predicted on theoretical grounds (Abstr. 10122/1955; Abstr. 9843/1954). D.R.Barber

551.521.326

6547. INFRARED SPECTRUM OF THE NORTHERN NIGHT SKY IN THE REGION 9500-11 500 A. N.I.Fedorova.
Astron. Zh., Vol. 34, No. 2, 247-9 (1957). In Russian.

The relative intensities of hydroxyl bands recorded in February 1955, near Murmansk, are reported. A spectrograph with an electron-optical converter having a dispersion of 230 Å/mm was employed. The results are compared with the absolute intensities as calculated by Roach for the near i.r. region (Manual for photometric observations of the Airglow during the I.G.Y., Sept. 1956, meeting of CSAGJ in Barcelona). They are not in agreement with Roach's data, but agree well with those of Lukashenya and Krasovskiĭ (Abstr. 9853/1951).

S.Chomet

551.521.326

6548. THE INTENSITIES OF THE NIGHT-SKY EMISSION BANDS IN THE NEAR INFRARED. M.Dufay.
C.R. Acad. Sci. (Paris), Vol. 246, No. 15, 2281-3 (April 14, 1958). In French.

Spectrophotometric recording of the i.r. bands of OH, and of atmospheric O_2 with a photoelectric monochromator (resolving power, 15 A) shows a significant positive correlation between the intensity of O_2 emission at 8640 A and that of the forbidden [O I] emission at 5577 A. D.R.Barber

551.521.326

6549. NIGHTGLOW EMISSION ALTITUDES FROM ROCKET MEASUREMENTS. J.P.Heppner and L.H.Meredith.
J. geophys. Res., Vol. 63, No. 1, 51-65 (March, 1958).

Four rocket-borne photometers measured nightglow emissions near 6300, 5893, 5577 and 5335 A. The emitting region of the oxygen green line (5577 A) was entirely between 90 and 118 km, and had a very sharp lower boundary. The sodium D-lines were encountered primarily between 85 and 110 km, with a maximum intensity at 93 km. The upper boundary of D-line emission was not definite, due to tailing off of the distribution and low total intensity, but D-line emission extending into the 130 to 150 km region is indicated. The 6300 A photometer showed two distinct features: an emitting region from 56 to 100 km, and a large signal still present at the peak of flight, 163 km. The 56 to 100 km emission is attributed to the (9-3) Meinel OH band, and it is concluded that the region of oxygen red line emission must lie above 163 km. On the basis of relative band intensities for the Meinel OH bands and the dissimilarity of the signal-vs-altitude curves for the 5335 A and 6300 A photometers, it is concluded that practically all atmospheric emission near 5335 A is due to an atmospheric "continuum" and not due to OH band emission. This atmospheric "continuum" has a maximum intensity between 100 and 110 km, and is at least as bright as the stellar background. During descent of the rocket through the E-region, the photometers recorded a bright glow in the rocket's wake. Energy for creating the glow had to come from atmospheric gases and not the rocket. Its spectra and other features are discussed.

A.

551.521.326

6550. LATITUDE EFFECT OF NIGHT AIRGLOW. J.Nakamura.
J. geophys. Res., Vol. 62, No. 3, 487-8 (Sept., 1957).

Experiments aboard the "Soya" suggest that the airglow has a seasonal variation and three minima at 0° and $\pm 20^{\circ}$ of the geomagnetic latitude. It is suggested that u.v. rays and charged particles are the cause of the airglow.

J.M.Hough

551.521.326

6551. PHOTOELECTRIC STUDIES OF NEAR INFRARED OH EMISSIONS OF THE NIGHT SKY. I.
M.Ogawa, M.Nakamura and A.Hashizume.
Sci. of Light (Tokyo), Vol. 5, No. 3, 139-46 (Dec., 1956).

A photometer for surveying the near infrared OH emission of the night sky has been made. (1) An Ag—Cs photocell tube is used for the detector. (2) In order to eliminate the zero drift which appears in the direct dark current of the photocell, a.c. amplification is adopted. (3) A synchronous rectifier is used to reduce the noise which appears in the output of amplifier. With this arrangement, the intensity distribution of the emission and its variation with time are surveyed with an altazimuth covering the entire sky.

A.

551.521.326

6552. PHOTOELECTRIC STUDIES OF NEAR INFRARED OH EMISSIONS OF NIGHT SKY. II. MEASUREMENT OF ABSOLUTE INTENSITY AND BRIGHTNESS STANDARD. R.Onaka and R.Onaka and M.Nakamura.
Sci. of Light (Tokyo), Vol. 6, No. 3, 95-100 (Dec., 1957).

For Pt I see preceding abstract. Some problems on the estimation of the absolute intensity of OH emission in night airglow are discussed, and a method which seems best to express the absolute intensity is proposed. In addition, a brightness standard constructed for the calibration of photometer is described.

A.

551.521.6

6553. HIGH ALTITUDE INFRARED STUDIES OF THE ATMOSPHERE. D.Murcray, J.Brooks, F.Murcray and C.Shaw.
J. geophys. Res., Vol. 63, No. 2, 289-99 (June, 1958).

The results obtained from a flight with a balloon-borne i.r. spectrometer are described. The spectrometer was designed to scan from the visible to 4.3 μ, but on this flight only the region from the visible to 2.7 μ was obtained. In this region, the bands of interest are the 1.4 μ and 1.9 μ H_2O bands. Spectra were obtained from the ground to 65 000 ft. The water vapour bands had completely disappeared above 46 000 ft.

A.

551.521.6

6554. 3303 A EMISSION FROM SODIUM EJECTED INTO THE UPPER ATMOSPHERE.
C.D.Cooper, E.R.Manring and J.F.Bedinger.
J. geophys. Res., Vol. 63, No. 2, 369-71 (June, 1958).

The emission of both 5893 A and 3303 A was observed from a sodium cloud in the upper atmosphere. The yellow line is at least 100 times more intense than the ultraviolet line. The appearance of the 3303 A line with the observed intensity proves conclusively that the sodium twilight flash results from resonance scattering.

A

551.521.6

6555. INVESTIGATION OF THE SHORT-WAVE ULTRAVIOLET RADIATION FROM THE SUN.
S.L.Mandel'shtam and A.I.Efremov.
Uspekhi fiz. Nauk, Vol. 63, No. 1b, 163-80 (1957). In Russian.

The present paper sets out briefly the results of experimental and theoretical work on the study of the short-wave emission from the sun published since an earlier review (1952, ibid.). Experiments are also described which, it is suggested, could be profitably carried out with the aid of an artificial-earth satellite.

C.R.S.Mander

551.593.

6556. THEORY OF THE SOLAR AUREOLE. I. SCATTERING AND RADIATIVE TRANSFER. D.Deirmendjian.
Ann. Geophys., Vol. 13, No. 4, 286-306 (Oct.-Dec., 1957).

Theory of the clear sky aureole around the sun is discussed as a problem of radiative transfer in a plane-parallel, scattering atmosphere containing two types of particles: molecules characterized by the symmetrical Rayleigh scattering and a few larger spherical dielectric particles characterized by a highly asymmetrical, forward-scattering pattern. For a single-scattering process of the latter type, the classical series solution of Mie is replaced by the approximation proposed by Saxon (Abstr. 1409/1956) making use of an integral representation of the amplitude of the scattered electromagnetic wave. After verifying the high degree of approximation thus obtained to the exact scattering pattern near the forward direction, it is shown how it can be used in the equation of radiative transfer for a turbid atmosphere, as formulated by Sekera (Advances in Geophysics, Vol. III. New York: Academic Press, 1956, 43-104, and Abstr. 6770/1957), in evaluating the effects of turbidity on the theoretical skylight corresponding to a Rayleigh atmosphere.

A

551.594.12

6557. MEASUREMENT OF THE POSITIVE ION DENSITY ALONG THE ORBIT OF AN ARTIFICIAL EARTH SATELLITE.
K.I.Gringauz and M.Kh.Zelikman.
Uspekhi fiz. Nauk, Vol. 63, No. 1b, 239-52 (1957). In Russian.

Among topics dealt with are: the distribution of charged particles around the satellite, the potential of the satellite, experimental layout for the measurements and its physical principles, an estimate of the effects distorting the measurements.

C.R.S.Mander

551.594.14

6558. THE IONIZATION DUE TO BETA RADIATION FROM THE ATMOSPHERE. H.A.Miranda, Jr.
J. geophys. Res., Vol. 63, No. 1, 147-55 (March, 1958).

The measurements were made using two thin-walled ionization chambers in a differential arrangement. Corrections for geometry, absorption of beta and gamma radiation in the shield, formation of secondary betas in the shield, and back-scattering of beas within the chamber are discussed. The results of 73 measurements, taken throughout the summers of 1955 and 1956, are reported. Two-thirds of all the measurements fall within a range extending over one order of magnitude. The weighted mean of all the measurements is 0.67 I. This is roughly ten times the expected value, computed from radon and thoron concentrations measured at this locality. Wide (and rapid) fluctuations in ionization current were also noted. All the mechanisms coming to mind which might account for the excess ionization observed over that expected are discussed, and rejected on various grounds. By process of elimination, the possibility of the existence of a "very soft" cosmic-ray component is suggested.

A.

551.594.14 : 553.495

6559. A STUDY OF THE DISTRIBUTION OF RADON, THORON, AND THEIR DECAY PRODUCTS ABOVE AND BELOW THE GROUND.
S.L.Jaki and V.F.Hess.
J. geophys. Res., Vol. 63, No. 2, 373-90 (June, 1958).

The respective concentrations of radon, thoron, and their decay products were measured immediately above the earth and below the ground, and a study of their correlation with meteorological conditions was carried out. It was found that the concentration of radon and thoron in the vicinity of the earth's surface depends primarily on the dryness of the ground. Measurements at and below the ground level

were carried out by an indirect method, collecting the decay products of radon and thoron on the inner surface of an aluminium cylinder charged to -600 V. From 6 November 1956 to 7 May 1957, 239 experiments were made. It was found that the concentration of thoron below the ground seems to reach a maximum value at a depth of about 75 cm, whereas the concentration of radon shows a continuous increase within the range investigated. Comparison with other experiments shows that the cylinder method can be used for investigating the exhalation of both radon and thoron at the surface of the ground. The mean value obtained for radon is 6×10^{-18} curie per cm^2 sec. The measurements presented here give the first data on the exhalation of thoron through the air—soil interface. A.

551.594.5

6560. X-RAYS FROM VISIBLE AURORAE AT MINNEAPOLIS. J.R.Winckler, L.Peterson, R.Arnoldy and R.Hoffman.
Phys. Rev., Vol. 110, No. 6, 1221-31 (June 15, 1958).

During there auroral storms on June 30-July 1, September 12-13, and September 22-23, 1957, bursts of X-rays were observed during balloon flights at 10 g/cm^2 depth in the atmosphere over Minneapolis. The X-rays have an energy of from 50 to 100 keV, an integral intensity from 0.03 to 0.14 mr, and a maximum measured peak intensity of 0.4 mr/hr. One burst was observed at 47 g/cm^2 atmospheric depth (70 000 ft), it is estimated that above the atmosphere this may have corresponded to 500 mr/hr for at least 10 minutes. The current of high-energy electrons is at least 3×10^6 electrons/cm^2 sec, and probably an order of magnitude greater, and is therefore approximately equal to auroral proton fluxes, and to the fluxes observed in soft radiation at rocket heights. The X-ray bursts usually appear when a homogeneous auroral arc develops a strong ray structure, or when rays increase in intensity. The inferred energy and high velocity of the primary auroral electrons necessitates an acceleration mechanism near the earth to avoid contradictions with the commonly accepted sun-earth transit times for corpuscular beams. A.

551.594.51

6561. THE EFFECT OF SPIRAL TRAJECTORIES OF PROTONS ON THE CALCULATED DOPPLER PROFILE OF HYDROGEN LINES OF AURORAE. B.A.Bagaryatskiĭ.
Astron Zh., Vol. 35, No. 1, 101-11 (1958). In Russian.

The Doppler profile of the Hα line in the spectrum of aurorae is calculated. The starting assumptions are essentially the same as those used by Chamberlain (Abstr. 11675/1954, 5804/1955) and Omholt (Abstr. 7903/1956), but in addition the spiral form of the proton trajectories in the magnetic field are taken into account. The magnetic field is taken as being effectively due to a monopole. The depth of penetration into the atmosphere of a stream of particles having different initial velocities is calculated. The initial velocity is not introduced explicitly and the height of the lower boundary of the aurora is taken as the parameter. The angular distribution of protons is obtained on the assumption of an initially uniform beam which is then dispersed by the non-uniform field. The Doppler profile thus obtained is not in agreement with observations. It is suggested that better agreement may be obtained by taking into account (a) elastic and inelastic scattering of protons and (b) the electrostatic field due to the particles which penetrate into the atmosphere. S.Chomet

551.594.52

6562. LOW-LATITUDE REFLECTIONS FROM THE AURORA AUSTRALIS. T.J.Seed and C.D.Ellyett.
Austral. J. Phys., Vol. 11, No. 1, 126-9 (March, 1958).

Ten auroral radar observations at the low geomagnetic latitude of 47.8°S, made near Christchurch (New Zealand) from 5th March to 11th June 1957 on a frequency of 69 Mc/s, yielded computed echo heights ranging from 93 to 152 km, with a mean height of 127 ± 18 km. D.R.Barber

551.594.6 : 551.594.221

6563. THE "NOSE" WHISTLER — A NEW HIGH-LATITUDE PHENOMENON. R.A.Helliwell, J.H.Crary, J.H.Pope and R.L.Smith.
J. geophys. Res., Vol. 61, No. 1, 139-42 (March, 1956).

Whistlers exhibiting both falling and rising tones from a starting ("nose") frequency have been observed at College, Alaska. These often occur in trains with the nose frequency gradually descending in time. It is proposed that these whistlers originate from lightning-discharge impulses propagated along dispersive paths along lines of the earth's magnetic field, similar to conventional whistlers, the nose frequency corresponding to the frequency at which the energy is propagated with maximum velocity. The condition is realized for the longitudinal extraordinary mode for a frequency which is some fraction of the gyro-frequency, and its magnitude shows that a substantial contribution to the total dispersion must occur near the top of the path where the gyro-frequency is relatively low. G.M.Brown

BIOLOGY

578.08 : 539.1.07

6564. A PORTABLE APPARATUS FOR RECORDING THE RATE OF CLEARANCE OF RADIOACTIVE SODIUM FROM HUMAN CALF MUSCLE. L.Molyneux, J. Turnbull and D.N.Walder.
J. sci. Instrum., Vol. 35, No. 7, 259-61 (July, 1958).

The apparatus consists of a halogen quenched G.M. counter, which straps over the muscle to be tested, and a light pack which is carried on the subject's back. The pack contains, in addition to batteries, the h.t. generator for the counter, an electronic circuit in which alternate pulses from the counter are used to trigger a pulse generator, a wire recorder to record the pulses, and a ratemeter for monitoring purposes. The record obtained on the wire recorder is subsequently played back in the laboratory, and after amplification the pulses are fed back into the monitoring ratemeter, the output from which is amplified and used to drive a recording milliammeter. A.

MEDICAL SCIENCE. HUMAN PHYSIOLOGY

612.014.481./482 : 539.166

GAMMA RADIATION FROM SOME SWEDISH FOODSTUFFS.
See Abstr. 6267

612

6565. BIOLOGICAL AND MEDICAL ACOUSTICS. W.J.Fry.
J. Acoust. Soc. Amer., Vol. 30, No. 5, 387-93 (May, 1958).

Paper read at the Acoustical Society of America symposium on "Unsolved problems in acoustics", October 1957, referring to recent developments on the use of (a) low intensity sound waves in the study and identification of macro- and microstructures; and (b) high intensity waves to weaken bonds in macromolecules in cells and thus affecting the subsequent behaviour of the latter. Applications to the possible control of cancer and of malignant tumors and to neurosurgery are reviewed. H.D.Parbrook

612.816

6566. PHYSICS OF NERVE PROCESSES. P.Fatt.
Rep. Progr. Phys., Vol. 21, 112-43 (1958).

Since 1938 investigations have been made on single nerve fibres and similar material to determine the electrical properties of their surface membrane, which is the structure primarily concerned in excitatory phenomena including the propagation of the nerve impulse. In the resting state the fibre has the characteristics of a leaky capacitative cable. Across the surface of large invertebrate nerve fibres there is a capacity of about 1 μF cm^{-2} in parallel with a resistance of 1000 Ω cm^2 or more. An essential feature of the nerve impulse is the action potential, a transient alteration of membrane potential, which has an amplitude of about 100 mV, lasts about 1 msec at a given position along the fibre, and propagates at a rate of about 20 m sec^{-1}. The membrane resistance decreases during the action potential, while the capacity is unaltered. After the capacitative current has been deducted, the current that flows across the membrane when the potential is displaced from its resting level to a level corresponding to a point on the action potential can be analysed into a component due to a movement of sodium ions and another due to a movement of potassium. The

driving force operating on these ions is determined by their concentrations on the two sides of the membrane and the potential difference across it, while the permeability of the membrane potential and time. The rising phase of the action potential is produced by an increase in membrane permeability toward sodium ions, and the falling phase by a delayed increase in permeability toward potassium. In vertebrate nerve fibres that conduct impulses at high speed the process for the generation of the action potential occurs in restricted regions separated by lengths of fibre which serve as cable conductors and which have a thick layer of insulating material at their surface. Action potentials similar to those in the nerve fibre can be generated in some muscle fibres, though not in others. At the junction between a nerve and muscle fibre or between two nerve cells excitatory influences are transmitted by different mechanisms from those involved in the propagation of impulses within the fibre or cell. A.

612.843

6567. STATIONARY RETINAL IMAGE REQUIRING NO ATTACHMENTS TO THE EYE. F.Ratliff.
J. Opt. Soc. Amer., Vol. 48, No. 4, 274-5 (April, 1958).

Haidinger's brushes provide a means for studying the effects of stabilized retinal images. R.A.Weale

612.843.16

6568. ON THE ELECTRICAL RESPONSE OF THE HUMAN EYE TO RED STIMULI OF DIFFERENT TIME DISTRIBUTION OF LUMINANCE. L.Ronchi.
J. Opt. Soc. Amer., Vol. 48, No. 7, 437-8 (July, 1958).

The responses to red stimuli presenting different distributions of time–luminance are compared. The height of the x-wave seems to be independent of time distribution of the light stimulus while the height of the b-wave is greater, the greater the time of variation of the luminance. The latencies to peak of both waves are greater with a slowly rising stimulus than with a steep stimulus. A.

612.843.2

6569. ON SOME PROPERTIES OF NONTHRESHOLD FLICKER. F.Veringa.
J. Opt. Soc. Amer., Vol. 48, No. 7, 500-2 (July, 1958).

Flicker experiments were done at various luminance levels, modulation between 20 and 80% providing an additional parameter. R.A.Weale

612.843.37 : 598.65

6570. RISE IN THE PIGEON'S THRESHOLD WITH A RED TEST STIMULUS DURING DARK ADAPTATION. D.S.Blough.
J. Opt. Soc. Amer., Vol. 48, No. 4, 274 (April, 1958).

The visual threshold of dark-adapting pigeons rises temporarily following exposure to a deep-red light. The latent period of the rise varies with the duration of the pre-exposure. R.A.Weale

612.85

6571. PHYSIOLOGICAL AND PSYCHOLOGICAL ACOUSTICS. M.Lawrence.
J. Acoust. Soc. Amer., Vol. 30, No. 5, 394-6 (May, 1958).

Paper read at the Acoustical Society of America symposium on "Unsolved problems in acoustics", October 1957, referring to the need for (a) research to reveal the phenomena of hearing; (b) an examination of the "facts" reported in studies of hearing and conclusions drawn from them; and (c) an examination and explanation of the hearing divergences about the statistically mean values in people with normal hearing. H.D.Parbrook

614.898

6572. POSSIBLE IMPROVEMENT OF MASKS AND FILTERS FOR PROTECTION AGAINST RADIOACTIVE POWDERS. P.O.Robert.
C.R. Acad. Sci. (Paris), Vol. 246, No. 20, 2886-9 (May 19, 1958). In French.

Even with the best filters, in a heavily contaminated atmosphere it would be possible for the alveoli of the lungs to retain, in 8 hours, 80 times the maximum quantity of radioactive material tolerable over a lifetime. "Multiple-layer" filters, however, give a much better protection, allowing safe exposure for many hours. Data on the performance of standard and multiple-layer filters are given, with some details of their construction. C.B.Allsopp

LIST OF JOURNALS

The following list supplements the List of Journals published with the June number of Volume 60 (1957) and the Supplement published with the Index to the same volume. Reprints of the List of Journals and of the Supplement can be obtained from The Institution of Electrical Engineers, Savoy Place, London, W.C.2, price 2s.0d. post free.

The addresses given are believed to be correct at the date of publication, but no responsibility can be accepted for errors.

Bull. Inst. Chem. Res. Kyoto Univ.	Bulletin of the Institute of Chemical Research of Kyoto University. Kyoto.
Rev. d'Électrotech. et d'Énergétique	Revue d'Électrotechnique et d'Énergétique. Institutul de Energetica, Căsuța Poștală 142, Bucarest I.
Soviet Physics — Acoustics	Soviet Physics — Acoustics. American Institute of Physics, 335 East 45th Street, New York 17, N.Y. [A translation of the Journal of Acoustics of the Academy of Sciences of the USSR (Akusticheskii Zhurnal).]
Soviet Physics — "Doklady" (New York)	Soviet Physics — "Doklady". American Institute of Physics, 335 East 45th Street, New York 17, N.Y. [A translation of the "Physics Section" of the Proceedings of the Academy of Sciences of the USSR (Doklady Akademiya Nauk SSSR).]
Stud. Cercetări Energetică	Studii si Cercetări de Energetică. Institutul de Energetica, Căsuța Poștală 142, Bucarest I.
Telecomunicații	Telecomunicații. Revistele Tehnica, Str. Ion Ghica 3, Bucarest.

NEW JOURNAL

Nukleonik	Nukleonik. Springer-Verlag, Reichpietschufer 20, Berlin, W.35, and Neuenheimer Landstrasse 28-30, Heidelberg (17a). Vol. 1, No. 1 dated April, 1958.

ERRATA

Author Index (1957) p. 1006, column 1 : for "Noggle,T.S. and Kohler,J.S." read "Noggle,T.S. and Koehler,J.S."
Abstr. 18 (1958) line 11: for "the longitude decay of" read "longitude".
Abstr. 3862 (1958) line 3 : for "V.S.Neporent" read "B.S.Neporent".
Abstr. 5497 (1958) line 4 : for "preceding" read "following".
Abstr. 6079 (1958) line 9 : after "cylinder" insert "and the sign to be taken depends on the boundary condition assumed".

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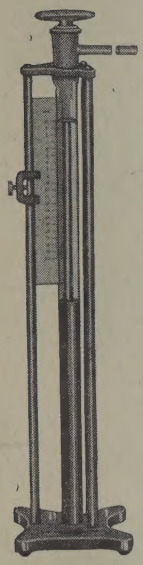

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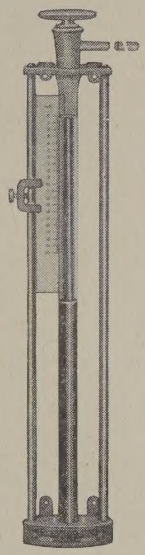

No. 1451H.
Wall Mounting

The Dubrovin Gauge indicates the pressure continuously, may be left in the system indefinitely, and is not damaged if the line is suddenly opened to atmospheric pressure. It is simple to install and convenient to use. A typical application for which it has proved especially convenient is the filling of tubes with gas at a specific pressure, as in the luminous-tube industry. It is useful wherever a sensitive gauge of this range is needed.

The action of the Dubrovin Gauge may be explained as follows. When both the float chamber and gauge chamber have been evacuated, the buoyant force acting on the float (the weight of the mercury displaced by its submerged walls) is in equilibrium with the weight of the float. Under these conditions the float is in its highest position. When the pressure in the outer chamber increases it exerts a downward force on the float, causing it to sink until the additional mercury displaced is sufficient to compensate for the downward force and again produce equilibrium. The magnification factor is a function of the dimensions of the float.

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1451C	0.50 to 20.	6	1	soft-glass	Table	$47.50
1451D	,, ,, ,,	,,	,,	Pyrex Brand	Table	47.50
1451G	,, ,, ,,	,,	,,	soft-glass	Wall	47.50
1451H	,, ,, ,,	,,	,,	Pyrex Brand	Wall	47.50
1451E	0.2 ,, ,,	9	2¼	soft-glass	Table	55.00
1451F	,, ,, ,,	,,	,,	Pyrex Brand	Table	55.00
1451J	,, ,, ,,	,,	,,	soft-glass	Wall	55.00
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NOTE: The use of C.P. mercury is essential for the proper operation of Dubrovin Gauges

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